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The Car Inspectors' Competition

More papers were received in the car inspectors' competition than in any competition that we have ever held, and the indications are that much valuable data is contained in them. They have been referred to the judges in the contest, and it is planned, if the decision is received in time, to publish the prize winner in the November issue. We take this opportunity of again thanking those who contributed and helped to make it a success.

The Railway Electrical Engineer

The Simmons-Boardman Publishing Company, publishers of the Railway Age Gazette; *Railway Age Gazette, Mechanical Edition;* and The Signal Engineer, has purchased the Railway Electrical Engineer, which has been published for several years in the interests of electrical men in steam railway service. The number of cases of partial electrification of steam roads in recent years, and the promise of more extensive development along this line in the near future, together with the growing use of electricity on railway equipment of all kinds and in the operation of shops, engine houses, offices and yards, make necessary the development of a strong journal in this field. The Railway Electrical Engineer will cover it in detail in the same way as the *Mechanical Edition* does the mechanical department. It will not conflict with the Railway Age Gazette, which will consider the electrical problems in their broader aspects and for the information of the higher officers. On the other hand, both the *Mechanical Edition* and the Railway Age Gazette will profit by having a strong electrical editorial staff co-operating with them.

Steel Freight Car Competition

Steel freight cars have now been in service in large quantities on a number of roads for a sufficiently long time to develop their weak points and enable car department officers to place their fingers on those parts or features which need further attention. What are the weak points of steel freight cars, and how should they be strengthened? We invite discussion from both the practical car man and the designer. Too often these two classes do not work closely enough together; sometimes the car designer neglects to follow the cars after they are put in service. Then, too, the practical

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man who takes care of them, and repairs them, does not always understand how to bring his superiors to a full realization of the importance of the defects which he discovers. With this in mind, we invite car men, as well as designers and others, to participate in a competition on the subject of "Lessons to be Learned from Experience with Steel Freight Cars." For the best contribution on this subject received at our offices in the Woolworth building, New York, on or before December 1, 1915, we will give a prize of $35. Other contributions which we may select for publication will be paid for at our regular rates. The judges will base their decision on the practical value of the suggestions which are made.

Education of Locomotive Firemen

"For whatsoever a man soweth, that shall he also reap"—a quotation from the Bible, familiar to all, and never more true than in the case of educating the locomotive firemen and supervising their work. It has been shown in many cases how by proper education and supervision the coal bill has been materially reduced with a very large return on the money spent for the education and supervision. This year the Traveling Engineers' Association received a very complete and instructive report on this subject. It was clearly shown that in addition to the direct results obtained from the reduction in the consumption of fuel a better understanding would be obtained between the firemen and their superiors if the instruction were given in the proper spirit. Realizing that the company was spending money for their education and that it was thoroughly interested in making them a success in their chosen profession, there will naturally be created a relationship between the firemen and the officers they serve that is certain to be of great indirect advantage to all the roads on which such practices are followed.

It is the most natural thing for the average man to want to learn and improve his condition, and he who assists in this respect is that man's friend. Two results are thus obtained—a decrease in fuel consumption and a friendly employee, one who has faith in his officers and whose aim is to further their best interests. Locomotives consume over $250,000,000 worth of fuel each year. One-half of one per cent of this amount would pay for a supervisor at $1,800 a year for approximately every 100 engines in service on the roads of this country, who, in order to earn his salary, must save one scoop of coal out of every 200 shoveled by the firemen and hostlers under his jurisdiction. This is an absurdly simple thing to do, as the results have shown on those roads that have even the poorest systems of education and supervision. All above the one shovelfull per 200 is clear profit for the railroads, and it will be found that the investment will prove most profitable.

Boiler Inspection Competition

The first announcement of the boiler inspection competition was made in our September issue, page 439. With the inauguration of the federal locomotive boiler inspection requirements a few years ago the railroads found it necessary to give much more attention to boiler inspection than they had in the past, and to develop a force of capable inspectors of their own. These men, to perform their work efficiently and effectively, must be provided with certain facilities and must use the best methods and practices. They are widely scattered, however, and have not had opportunities of getting together and comparing notes. True, they have had the benefit of advice from the federal inspectors, each one of whom covers a considerable amount of territory, but even these men were new on the job. Some of the more progressive inspectors have developed facilities and methods of performing their work which are far beyond the average; some excell in one respect, others in another. The purpose, then, of this competition is to encourage those who have developed and are familiar with those practices and methods to send in descriptions of them in order that we may act as a sort of clearing house for such data. You may say that you are located at a small or unimportant point, and are not capable of discussing the matter in the way that your friend at a larger terminal with better facilities may be able to do. Remember that there are many others situated as you are, and that it is just as important to place on record the best way of doing things at the smaller and comparatively unimportant places as it is at the larger ones. Possibly more so, for these smaller terminals far outnumber the larger ones. The object of the competition is to develop facts and practical suggestions which will help improve the effectiveness of the locomotive boiler inspector. A prize of $35 will be given for the best article on this subject which is received at our offices in the Woolworth building, New York, on or before November 1. The judges will base their decision on the practical value of the article rather than on its composition or grammatical arrangement.

Eliminate Old Equipment from Interchange Service

There has been so much trouble caused by the bad order freight cars in the Chicago switching district in the past that a committee was appointed by the General Superintendents' Association of Chicago to investigate this problem. This committee has made its report to that association, and the report was also presented as a paper before the Western Railway Club, an abstract of which appears elsewhere in this issue, for the purpose of obtaining as much discussion on the subject as possible. The investigation of the committee was very thorough, and a number of very valuable suggestions were made. But the committee, being made up of transportation officers, was not thoroughly conversant with the difficulties experienced by the mechanical department in the handling of bad order cars the country over, and its criticism of the M. C. B. rules savored a little of the idealist.

There is no question that the bad order cars are an unmitigated nuisance, especially when it is considered that in Chicago alone 29,779 loads were transferred last year on account of defective equipment, and most of those cars, it is believed, were loaded while in that condition. That, of course, is inexcusable, and demonstrates the lack of proper inspection. There is another point which also should be considered, and that is the unrestricted interchange of old and what might be termed unfit equipment. Leaving the M. C. B. rules as they are, which, though far from perfect, undoubtedly take care of the freight equipment the country over as well as possible under the present conditions, a tighter line may be drawn on the equipment to be allowed off the home rails. It is to be expected that the wooden cars will not stand the present day service in the long trains and hump yards when mixed in with a lot of stiff steel underframe cars. These cars transmitting more and absorbing less of the shocks, batter the wooden weaklings into "bad orders" much quicker than if all the equipment were of wood.

This is a period of transition, and as the quantity of the reinforced equipment increases, so should more of the weaker wooden equipment be kept at home. The M. C. B. Association has already agreed not to permit the interchange of equipment of capacity under 60,000 lb. after October 1, 1916, and until that time every road should, of its own accord, limit the use of that equipment in so far as possible.

The Apprentice Letter Competition

Eighteen letters were received in the contest on "How Can I Help the Apprentice Boys?" which was announced in our August issue, page 439. Three of the letters were disqualified as far as awarding the prize was concerned because of their length, the announcement distinctly stating that they should not contain more than 650 words. Several

of the writers apparently overlooked the "I" in the question and described ideal apprentice systems, or apprentice systems now in use, rather than telling how they as individuals could be helpful to the apprentice. This too disqualified some of the letters. All, however, were good, and while they may not have met the particular requirements of the competition, possess sufficient merit to warrant our making use of them in whole or in part.

The judges found great difficulty in arriving at a decision, but finally awarded the prize of $10 to John Smith, of the Baltimore & Ohio, at Lorain, Ohio. Mr. Smith approaches the question from the standpoint of the boiler shop and pleads for sympathy and practical co-operation with the apprentice. His letter, together with three others which were selected at random, appears elsewhere in this issue. The others or extracts from them will appear in both the November and December issues.

The letters as a whole possess a peculiar value because of the widely varying viewpoints and experiences of the different writers. For instance, the positions held by the contributors vary from mechanic to assistant superintendent of motive power, and from apprentice instructor to assistant professor of machine design. Except for two apprentice instructors and two foremen all of the 18 writers have different titles. The machine shop, erecting shop, boiler shop, paint shop, air brake department and engine house are all represented. In addition there are a traveling inspector, two shop draftsmen, a special apprentice and a shop superintendent.

One thing stands out quite clearly and that is the appreciation of modern apprenticeship methods. Ten years ago this journal started to advocate such methods strenuously and has kept at it more or less steadily ever since. Apprenticeship methods on progressive roads have been revolutionized in that time, although much still remains to be done, and far too few roads have awakened to their responsibilities in the matter. The competition was not designed so much to develop this, however, as to suggest ways in which the individual officers, foremen or mechanics could lend their aid in helping the apprentice to make the best of his time and opportunities. "What can I do?" was the question. It is answered in many different ways, and we hope that our readers will be inspired to take a greater personal interest in the boys and young men with whom they come in contact in the shop and in the office.

A Car Department Association

At the recent convention of the Chief Interchange Car Inspectors' and Car Foremen's Association, President Hanson announced that plans were under consideration for widening the range of the work of the association. Under the plan now followed its efforts are practically all devoted to securing uniformity in the interpretation of the Master Car Builders' rules of interchange. The convention is held before the annual revisions go into effect on October 1, the time being quite largely used in the discussion of these rules, thus providing for uniformity in interpretation of the revisions when they become effective. Through the executive committee, which meets during the winter for that purpose, suggested revisions of the rules are considered and recommendations for needed changes are made to the arbitration committee of the Master Car Builders' Association.

The importance of the results which have come from the work of this association cannot be overestimated. It has undoubtedly been the means of eliminating much friction in the administration of the rules of interchange, and has succeeded in securing revisions in the rules to correct many evils and improve their operation. This work, however, is all of much more vital interest to the car inspector than to the car foreman. The object of the association as outlined in the constitution, in addition to the consideration of the rules of interchange, is to make such recommendations as are considered advantageous in the construction and maintenance of cars. This interests the foreman in so far as the relation of car construction to maintenance is concerned, but since matters of car design are largely in the hands of others than the car foreman, and are now being exhaustively considered by the Master Car Builders' Association, this feature does not seem to offer a profitable field for the future activity of the Chief Interchange Car Inspectors' and Car Foremen's Association. There are, however, many matters of prime interest to car department officers and foremen which this association could profitably consider. In the locomotive department there are several foremen's associations, each of which finds much to consider, and each of which has been of great benefit to the service in its particular field. The car shop and the repair track have their own peculiar problems, which are undoubtedly being solved in many different ways at different points. Where much of the work which should have the attention of skilled mechanics must be gotten out with unskilled labor, the problem of securing and training men is one which might well be considered by an association of car foremen and inspectors. How to remedy the present rather lax methods of dealing with defective car doors and leaky roofs might be profitably considered. And there are numerous problems of car shop and repair track organization and arrangement awaiting solution. In taking up these matters, the Chief Interchange Car Inspectors' and Car Foremen's Association will be greatly strengthening itself by increasing its capacity to be of service to one of the most important, and often the most neglected, departments of a railroad. The association is to be congratulated on the beginning which is being made in the announcement that prizes are to be offered for the three best papers secured on the subject of apprenticeship in the car department, for presentation before the next convention.

This need not be done at the expense of proper consideration of the rules of interchange. Now that a uniform understanding of these rules has generally been effected, much of the need for general discussion is eliminated. The determination and presentation of the points in the rules most needing consideration might be left in the hands of a committee, with a saving of much time to the association. Time might thus be made available for an open discussion of proposed revisions, which would be of considerable benefit in bringing about a better mutual understanding with a resulting reduction in the number of proposed revisions of a local nature.

NEW BOOKS

Oxy-Acetylene Welding and Cutting. By Calvin F. Swingle, M.E. 190 pages, 4½ in. by 6½ in. Illustrated. Bound in leather or cloth. Published by Frederick J. Drake & Co., Chicago. Price, $1.50 in leather; $1.00 in cloth.

This book is intended as a practical treatise on the subject of welding and cutting with the oxy-acetylene flame, and only so much of the theory pertaining to the subject has been included as will enable the practical man to acquire a thorough working understanding of the subject. After an introductory chapter dealing briefly with the adaptability of various methods of welding, several chapters are devoted to welding flames and the properties and methods of handling the gases most commonly used. This portion of the book is confined largely to the oxy-acetylene flame, which has the widest practical application, and touches only briefly on other gases which have been used with oxygen to a less extent in welding and cutting operations. The equipment used in welding and cutting is next discussed, after which the operation of the plant and the practices followed in welding and cutting are taken up. A final brief chapter is devoted to the subject of carbon removal with the oxygen torch. The book contains a large number of illustrations and tables.

COMMUNICATIONS

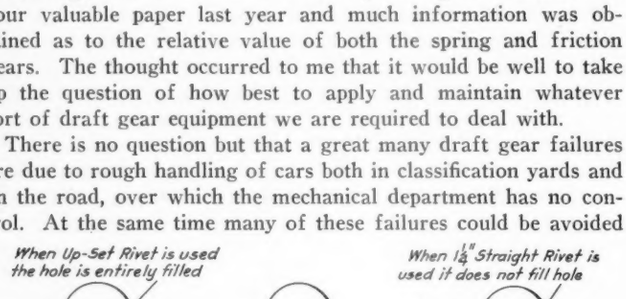
THE DRAFT GEAR PROBLEM

CLIFTON FORGE, Va.

TO THE EDITOR:

Draft gear was discussed extensively through the medium of your valuable paper last year and much information was obtained as to the relative value of both the spring and friction gears. The thought occurred to me that it would be well to take up the question of how best to apply and maintain whatever sort of draft gear equipment we are required to deal with.

There is no question but that a great many draft gear failures are due to rough handling of cars both in classification yards and on the road, over which the mechanical department has no control. At the same time many of these failures could be avoided


When Up-Set Rivet is used the hole is entirely filled
When 1¼" Straight Rivet is used it does not fill hole
1 5/16"
2 1/2"
1¼"
1 5/16"
1¼"

Illustrating the Advantage of Using the Upset Rivet for Fastening the Yoke to the Coupler

by the proper application and maintenance of the draft gear. The bulk of the failures are due to the coupler yoke and coupler parting at a point where they intersect, due to the poor method used in riveting the yoke to the coupler. The principal deficiencies that we find are as follows:

Rivets do not fill the hole in the coupler shank and yoke, which contributes very much to the rivets shearing. In many cases bolts are used that are entirely too small for the purpose, and the nuts work loose, due to the continuous vibration of the coupler. This permits the yoke to spread until the lug on the yoke is of no holding value and the rivets or bolts shear, causing a draft gear failure. It is general practice to use rivets 1¼ in. in diameter for riveting the yoke to the coupler. The rivet hole in the coupler and yoke is usually 15/16 in. in diameter, or 1/16 in. larger than the rivet. This allows the yoke to vibrate on the coupler and will, in my opinion, cause trouble sooner or later.

To eliminate this trouble we have adopted the practice of increasing the diameter of the coupler rivet under the head 1/16 in., as will be noted on the drawing. This is done in order to fill the rivet hole. The other end of the rivet is heated to a white heat, after which it is driven into position and riveted over with a pneumatic riveter, which forms a good head and upsets the rivet in the hole, filling it. This practice is no doubt saving the company many dollars, as up to the present we have not been able to find a single failure where it was used.

The friction and the spring draft gears both have their merits and demerits; however, I do not think that at this time the railroads of the country are in condition financially to make any great additions and betterments to their equipment, hence it should be the disposition of all who are in any way responsible for the maintenance of the equipment, to lend every effort to the application and upkeep of this important device. If this is done I am sure that there will be a decrease in draft gear failures, which are expensive to the railroads and retard traffic to a great extent.

E. A. MURRAY
Master Mechanic, Chesapeake & Ohio

STRENGTHENING OF UNDERFRAMES

CHICAGO, Ill.

TO THE EDITOR:

I have considered carefully your editorial on "Underframes Should Be Strengthened" in the July issue. You state that there seems to be but one remedy, the application of either a full steel underframe or steel center sills.

There is no doubt that the underframe is the foundation of any car, and it must be made sufficiently strong to withstand the severe shocks under the present conditions of service. This has been badly neglected on many railroads. However, from personal experience, I believe that the older cars, with wooden sills, can be strengthened enough to endure these shocks by the application of a steel arm, bolted to the center sill and extending a certain distance back of the body bolster—the steel arm having the draft gear pocket cast integral with it.

An L-shaped steel arm properly designed, going under and up the side of the center sill, lapping the body bolster and extending about 30 in. beyond, far enough at any rate to reinforce the sill at its weakest point, is of stronger construction than 60 per cent of the steel underframing under many cars now in service. It will stand greater shocks before the center sill will break.

The fact seems to be that on account of the difference in elasticity between wood and steel, the long slender steel center sill has to take all of the strain, and buckles under heavy impact, whereas the shorter steel arm delivers these stresses to the body bolster and spreads them over the entire wooden sill structure, which seems to have more resisting power than the steel center sill by itself. The weakness of the old wooden draft arms was the inadequate means of attaching the draft rigging to them and the difficulty of securing a proper attachment to the center sills and bolster. The steel arm, with the draft pocket cast integral and embracing the body bolster, seems to overcome these difficulties.

There are a great many 60,000 lb. capacity box cars and 80,000 lb. capacity wooden coal cars still in service, and it is necessary for the railroads to continue to run and maintain these cars. The application of a steel underframe, plated top and bottom, will cost approximately from $115 to $135, depending on the method of construction. The above mentioned steel arm, well designed, can be applied for approximately $70 to $85. This arm will strengthen such cars to meet the present traffic conditions and will save the railroad the difference in cost. The steel underframe means approximately $40 to $50 more expense per car and promises less endurance.

A steel arm can be applied without removing a cracked or split sill. It eliminates the heavy maintenance expenses of draft gears and also the delays to cars from draft sill repairs.

At the recent M. C. B. Convention the Committee on Car Construction ruled that the owner of a car equipped with steel arms would be allowed an additional amount of $65 if such a car were destroyed on another line. This would seem to indicate that some of the members of the committee felt that a car so equipped was strengthened sufficiently to meet the present requirements and necessities of traffic.

I do not mean to imply that full steel underframes should not be used on the new cars which are being constructed. I merely do not believe that it is necessary to go to the heavy expense they entail in the case of 60,000 lb. box and 80,000 lb. coal cars. That is the idea I wish to present for your consideration. J. T.

WATERPROOFING BLUEPRINTS.—Blueprint drawings made on paper can be readily waterproofed by placing them between pieces of muslin that have been saturated with paraffin and passing a hot smoothing iron over them, thus causing enough paraffin to be absorbed by the drawings to render them impervious to water. The paraffined cloths can be prepared by soaking pieces of muslin about 12 in. square in molten paraffin obtained by melting down paraffin candles. When thoroughly saturated the cloths should be hung in a warm place to drain and dry and when thus prepared can be used a number of times.—*Power.*

TRAVELING ENGINEERS' CONVENTION

Reports on Locomotive Appliances, Tonnage Rating, Education of Firemen and Smoke Prevention

The twenty-third annual convention of the Traveling Engineers' Association was held in Chicago, September 7-10, J. C. Petty, of the Nashville, Chattanooga & St. Louis, presiding. The opening prayer was made by Bishop Fallows, after which the president made a brief address of welcome. He also directed special attention to the economies that may be obtained by the co-operation of the traveling engineers with the other departments of a railway.

As is customary at the meetings of this association several special addresses were included in the program, in addition to the committee reports and technical papers. These included addresses by C. H. Markham, president, Illinois Central; F. W. Brazier, superintendent rolling stock, New York Central Lines east of Buffalo; Frank McManamy, chief inspector of locomotive boilers, Interstate Commerce Commission, and Warren S. Stone, grand chief, Brotherhood of Locomotive Engineers.

Mr. Markham took occasion to pay tribute to the courage, skill and intelligence of the engineer. He also spoke of the unfair attacks on railroads and the fact that there was entirely too much regulation. He urged unity of all railroad forces in the great movement toward securing a better understanding of railroad problems and better treatment of the railroads. He emphasized also the necessity of seeing that the internal relations of the railroads should be amicable, stating that a great strike would be followed by government ownership.

Mr. Brazier sketched briefly the development of locomotives and cars in recent years. He mentioned several prominent railway men that had started their railway careers on the locomotive, calling attention to the opportunities of the traveling engineer for advancement.

Mr. McManamy spoke of the necessity of obtaining good intelligent men as firemen, and called attention to the necessity of keeping locomotives in safe and serviceable condition. Since the boiler inspection law has been in effect accidents causing injury have been reduced by 51 per cent; the number killed from these accidents has been reduced 86 per cent, and the injured 54 per cent. This also must indicate a reduction in engine failures. He spoke of the locomotive inspection rules as being designed to protect the enginemen from injury due to defective equipment.

Warren S. Stone, grand chief, Brotherhood of Locomotive Engineers, made a brief address during the session Friday morning. He spoke of the traveling engineer as the intermediary between the engineer and the railway officers. Some roads are getting far better results from their enginemen than others, having obtained their implicit confidence by dealing with the men fairly and honestly. He called upon the traveling engineers to "play the game square" and to be sure and place the blame for an accident where it properly belongs, whether it be on the man, machine, roadbed, or wherever it may be.

MODERN APPLIANCES ON LARGE LOCOMOTIVES

Superheaters.—Two important changes in locomotive superheater practice that have been introduced since the last report of the committee on superheaters are a modified header design and a continuous pipe or torpedo unit. The construction of the header is such as to prevent the occurrence of stresses due to unequal expansion and contraction, by casting the saturated steam passage-ways free at one end. The continuous pipe unit is made by forging the return bends on the ends of the unit pipes. This unit reduces the restriction to the flow of gases.

The application of the superheater to the small locomotive raised the capacity limit 25 per cent to 30 per cent, and by the adoption of the superheater, larger engines, greater train lengths and faster schedules have been made possible.

The superheater under actual operating conditions saves 20 per cent of the total fuel burned and from 30 per cent to 35 per cent of the water used over the saturated locomotives developing the same horsepower. The superheater locomotive may be worked at longer cut-offs and at higher speeds, making possible longer trains and faster schedules than is possible with identical saturated locomotives, under the same conditions. The comparative curves shown in Fig. 1 give the average draw-bar horsepower developed at corresponding speeds of two Class H-21 locomotives on the Erie Railroad—engine 1625 used saturated steam and engine 1654 superheated. These curves show one of the advantages of superheating a locomotive, whose ability to haul full tonnage train over a railroad on a faster schedule is limited by the capacity of the engine boiler.

Tests made on the Central of Georgia with a superheater and a saturated steam locomotive in passenger service under practically the same conditions showed that for the superheater locomotive the cost of fuel per hundred miles run was $5.01, as against $5.89 for the saturated steam engine. On a basis of the fuel used per 1,000-ton miles the performance of the saturated steam locomotive was only 80.28 per cent as good as the superheater locomotive. The Grand Trunk has applied superheaters to a good many saturated steam locomotives and the benefit derived as shown by tests has been so much in favor of the superheater locomotive that the management has decided to superheat all road engines as they pass through the general shops. The following is a comparative result of tests with two simple Consolidation locomotives, one (623) having been converted to a superheater:

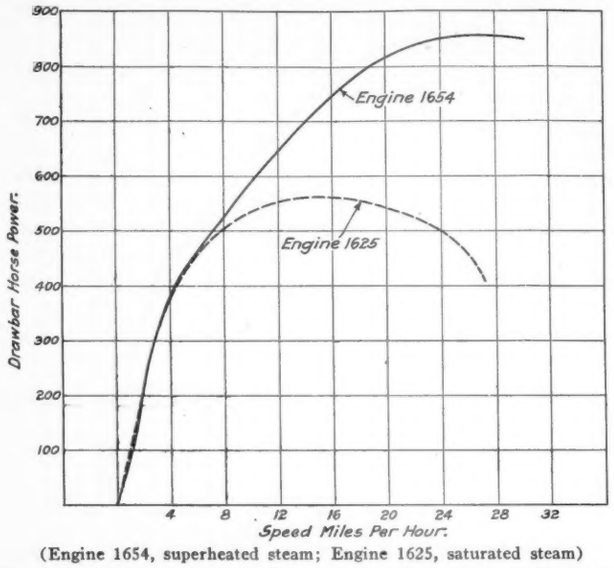
	Engine 825, simple consol. saturated steam	Engine 623, simple consol. superheat steam	Increase or decrease of superheated as compared with saturated locomotive (per cent)
Average number of cars in train	51.88	38.	26.07 D.
Total gross weight of train in tons	2,065.18	2,153.07	4.02 I.
Average weight per loaded car	39.62	57.79	45.08 I.
Total train miles	125.19	125.	.15 D.
Total car miles	6,497.	4,759.	26.07 D.
Total ton miles	258,964.	269,559.	4.09 I.
Coal consumed in pounds	21,307.	13,400.	31.01 D.
Coal consumed in lbs. per train mile	170.12	106.75	37.02 D.
Coal consumed in lbs. per car mile	3.27	2.95	9.08 D.
Coal consumed in lbs. per ton mile	.084	.050	30.04 D.
Total water evaporated in lbs.	137,614.	98,213.	28.06 D.
Water evaporated per lb. of coal	6.51	7.36	13.00 I.
Average boiler pressure	200.04	173.65	10.03 D.
Average speed in mile per hour	22.31	26.00	16.05 I.
Miles run with one ton of coal	11.82	18.76	58.07 I.
Actual running time	5 hr. 30 min.	4 hr. 49 min.	12.04 D.

The application of the superheater to the locomotive boiler, frequently inadequate as to heating surface, necessitates a reduction of about 15 per cent or 20 per cent in the tube heating surface. Notwithstanding this fact the use of superheaters has resulted in greater locomotive capacity. As an illustration of this fact, Fig. 2 is presented. It shows cylinder tractive effort in per cent plotted against piston speed. The lowest curve, No. 1, very fairly represents the speed factor for an average saturated steam locomotive. Curve No. 2 similarly represents the average modern superheated steam locomotive, using between 200 and 250 deg. of superheat. The greater tractive effort available is due to the fact that a longer cut-off is possible with the superheater engine than with saturated steam at the same speeds.

If the superheater designer were permitted to use a size of tube

different from the two present standards, it is possible to obtain in a superheater boiler an evaporating surface practically as great as in the saturated steam boiler. With a boiler and superheater thus arranged, a greater capacity may reasonably be expected, and a curve approximately that shown as No. 3 may be confidently looked forward to in the near future. This curve is representative of locomotives using 350 to 400 deg. of superheat.

There have been several pyrometers put in service on superheater locomotives during the past year, and as the engineers become more familiar with the purpose and operation of the



(Engine 1654, superheated steam; Engine 1625, saturated steam)

Fig. 1—Average Drawbar Horsepower Developed by Superheated and Saturated Steam Locomotives at Different Speeds

pyrometer, they realize more and more its importance. Those of the electrical type have been in service and operating continuously for a sufficient length of time to establish the fact that they may be depended upon in locomotive service. When the pyrometer fails to read 600 and 650 deg. when the engine is working steam it is an indication to the engineer that he is not handling the locomotive so that the maximum saving which the superheater makes available is being obtained.

Grates.—Judging from the number of replies received there are a large number of different designs of grates, varying in air space from 25 per cent to 50 per cent of total grate area. The committee is not in a position at the present time to recommend any particular design, but special attention should be given to the amount of air opening in the grates, using as large a per cent of the area as possible (40 per cent being a fair average).

Mechanical grate shakers are a decided advantage on heavy power and engines with large grate areas. They are of great assistance to the fireman in keeping the fire clean and in getting sufficient air through the grates, thus insuring thorough burning of the coal and gases. This device probably effects the greatest saving at the ash-pit when fires are being cleaned or dumped, as locomotives which were consuming 35 to 40 minutes from ash-pit to roundhouse are now consuming 10 to 20 minutes, and it only takes two men to handle the engine on the ash-pit, where it formerly took four—a reduction of 50 per cent in labor.

Drifting Valves.—The committee believes that some means should be provided to admit a sufficient amount of steam to cylinders and valve chambers, not only on superheat locomotives, but on any locomotive having cylinders of a large diameter. This will not only prevent carbonization, but will cause the engine to drift much more smoothly. The rods will require less keying up and the maintenance of wedges and journal bearings will be easier and piston heads and cylinders will not wear as fast.

Brick Arches.—Several years ago the brick arch was looked upon and spoken of only as a fuel-saving device, but the constantly increasing demand for greater capacity has resulted in changing its recognized function from a fuel saver to a capacity increaser. The arch increases the boiler capacity directly by aiding combustion and by reducing the heat losses. Naturally this results in increasing boiler efficiency. The arch tubes which support the brick add valuable heating surface and increase the circulation of water through the boiler. The brick arch separates the fuel bed from the tubes and forms a sort of combustion chamber in what would otherwise be a straight firebox. As shown in Fig. 3, the efficiency of the arch increases as the rate of combustion or the amount of coal burned per square foot of grate area per hour increases. When burning 30 lb. of coal per hour per square foot grate area, we may expect an efficiency of 3 per cent; when burning 100 lb. per hour per square foot of grate area, we may expect an efficiency of 10 per cent., etc.

Tests indicate that at a rate of combustion of 100 lb. of coal per square foot of grate area per hour, the arch will effect a reduction of 42 per cent in spark losses. This would mean an increase in boiler efficiency of 7 per cent, due to this one item. Reports from many roads indicate a smoke reduction of 50 per cent can be obtained by the use of the arch, and on most roads the brick arch, together with proper firing instructions, have proved sufficient to overcome objectionable smoke and to keep within the law.

Flange Oilers.—Ever since locomotives have been in use, the wear on the wheel flanges has been one of the, if not the, greatest sources of annoyance and expense in maintaining these powerful machines in service. The modern locomotive and high speed demanded has increased instead of decreased it. A very conservative estimate of the loss to one engine for one turning of tires on account of flange wear is $219. The following is an estimate of the mileage a locomotive will make between turning of tires for flange wear, with and without a flange oiler:

Freight		Passenger	
Miles without oiler	Miles with oiler	Miles without oiler	Miles with oiler
9,000 to 12,000	25,000 to 42,000	15,000 to 25,000	60,000 to 84,000

The rapid wear of the rails can be eliminated to a certain extent by the use of a flange oiler which positively delivers a jet of asphaltum oil against the flanges of the locomotive driving wheels. On one division of the Erie the rail saving on curves

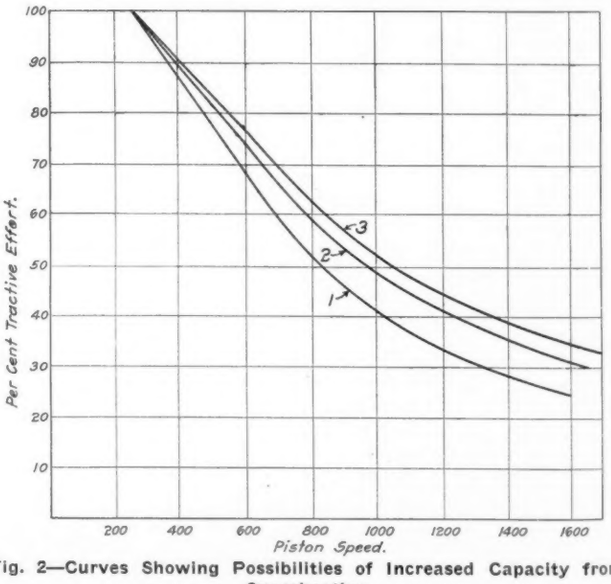


Fig. 2—Curves Showing Possibilities of Increased Capacity from Superheating

is 66 per cent. On the Delaware, Lackawanna & Western the saving on the rails on curves has warranted the equipping of locomotives with the flange oiler. While saving the rails on curves, the saving on the locomotive driving wheel tires on this road has been over 50 per cent. Positive proof is given by a number of roads that the flange oiler does prevent derailments.

It has been the impression that any crude oil would do to use

with any system of flange oiling. Service tests have proven that results cannot be obtained unless the oil contains from 40 per cent to 60 per cent of asphaltum in solution and is low in grease and paraffine. All oils that are low in asphaltum and high in grease and paraffine will run down on the tread of the driving wheel, causing slipping.

Mechanical Stokers.—In answer to questions submitted to the membership, the following replies were received: The stoker engines burn more coal, but as the grade of coal stoker fired is usually inferior to the coal used for hand firing, this feature should not be criticised too severely. With the same quality of coal there is very little difference. The hopper sometimes becoms clogged, causing stoker engine to stop in wet and freezing weather, but this depends largely on the watchfulness of the fireman. When the stoker fails, it usually causes an engine failure, due to the light fire carried and the grade of coal used,

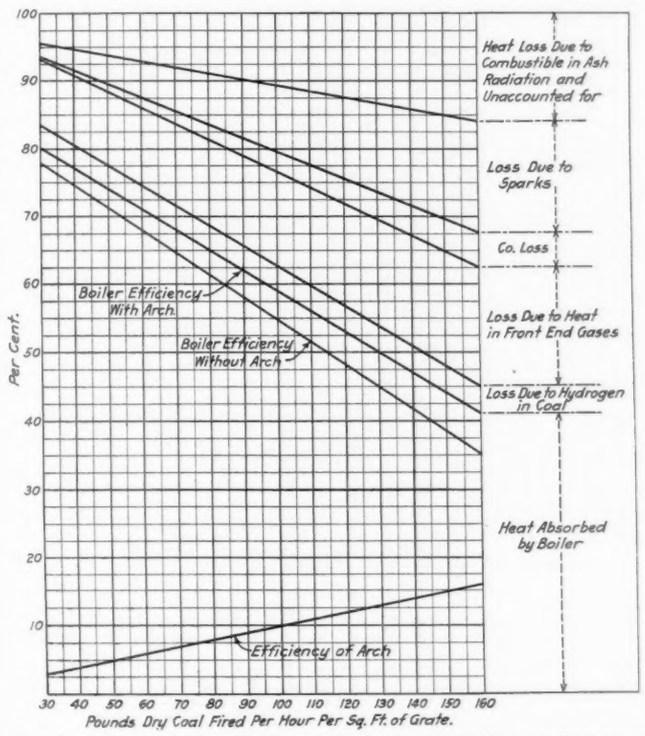

Heat Loss Due to Combustible in Ash Radiation and Unaccounted for
Loss Due to Sparks
Co. Loss
Loss Due to Heat in Front End Gases
Loss Due to Hydrogen in Coal
Heat Absorbed by Boiler
Boiler Efficiency With Arch
Boiler Efficiency Without Arch
Efficiency of Arch
Per Cent.
Pounds Dry Coal Fired Per Hour Per Sq. Ft. of Grate.

Fig. 3—Chart Showing Effect of Rate of Combustion on Efficiency of Boiler and Arch and on Heat Losses

making it impossible for a man to pick up the shovel and get the fire in condition without an engine failure, except in cases where the stoker is being worked very light.

In summing up, the advantages of the mechanical stoker are many. It is applied to heavy freight locomotives primarily to work the locomotive to its full capacity, regardless of the conditions under which it is operated, which, of course, means increased tonnage or increased average speed of freight trains under conditions where the tonnage is fixed—in other words, to increase the ton miles per hour over a division. Locomotives equipped with mechanical stokers carry a much lighter fire, which, of course, gives better combustion. A more uniform fire-box temperature is obtained, and correspondingly less flue and fire-box trouble. With the scatter system of firing a locomotive the smoke density will remain more uniform with the stoker-fired locomotive. The application of mechanical stokers to locomotives has made it possible for any fireman to handle any locomotive, regardless of the manner in which it is worked. By the use of the mechanical stoker the fireman is able to follow his engine more regularly, makes correspondingly more money, and, as a result, is better satisfied, a condition which makes it less difficult to keep a locomotive in service, especially on a division where the conditions of firing are particularly severe and the overtime runs high, due to the relief of firemen in the hot summer months.

On a number of roads a cheap grade of fuel is purchased especially for stoker-fired locomotives, and on other lines where conditions are such that small run-of-mine coal is supplied, an economy is effected in that the run-of-mine coal is screened and the poor coal is set aside for stoker-fired locomotives, leaving a much better grade of fuel for the hand-fired locomotives.

The following is a list of number of stokers in active operation, of different types:

Street	593	Gee	1
Crawford	301	Ayres	1
Standard	28	Kincaid	1
Hanna	18		

Power Reverse Gear.—Judging from the replies received, the power reverse gear is the ideal gear and is a decided advantage in freight and switching service and will soon pay for installation, due to time saved in making up trains and switching. In some cases the power reverse gear has not given the results expected of it in fast passenger service, principally owing to the neglect of certain small but important items of maintenance. The use of the screw reverse gear is advocated by many roads for fast passenger service owing to the possibility of very fine adjustment, but its principal drawback is its slowness in reversing, making it difficult to take slack.

Coal Passer.—It has been the experience of the chairman of the committee on the railroad with which he is connected, that locomotive tenders equipped with coal passers are a valuable asset to modern power. This device places the coal within easy reach of the fireman and eliminates the furnishing of men at different points to shovel the coal ahead. It also allows the doubling of divisions without taking coal, thereby reducing the amount of coal which has to be handled to the farthest terminal. The cost of maintenance of the coal passer is very low.

Automatic Fire Door.—The butterfly type of the automatic fire door is generally preferred to either the horizontal or vertical types. It is the smoothest working door, gives the least trouble on the road, and requires less repairs at terminals. By the use of this type of door, single-shovel firing is accomplished, which prevents a large amount of cold air from entering the fire-box and materially reduces the amount of fuel required to keep up steam pressure.

The report is signed by J. E. Ingling (Erie), chairman; P. J. Miller (N. Y. C. West.); H. F. Henson (N. & W.); W. A. Buckbee (Loco. Sup. Co.), and A. G. Kinyon (S. A. L.).

DISCUSSION

Representatives from the Erie strongly recommended the use of pyrometers on superheater locomotives, calling attention to the fact that a loss of 20 deg. of superheat will affect the evaporation of water one pound per indicated horsepower. The pyrometer also serves to give the fireman a much closer check on the condition of the fire and shows the engineer whether or not he is getting the most out of the engine.

The graphite lubricator has been found by several roads to materially increase the life of the cylinder packing rings. Tests on the Delaware, Lackawanna & Western demonstrated that by its use the valve leakage was reduced 51 per cent, and that there was a saving in fuel. In one test the fuel per 1,000-ton miles was decreased from 104.2 to 88.7 lb.

The question of using superheater or perfection valve oil on superheater locomotives received considerable attention. In almost every case the superheater oil was believed to be unsatisfactory in the air compressors, some roads providing separate lubricators with perfection oil to serve these attachments, while other roads use perfection oil for both the compressors and the cylinders. A. G. Kinyon contended that if it were possible to eliminate the air from the cylinders while the engine is drifting better results can be obtained with perfection oil than with the superheater oil, inasmuch as in the manufacture of superheater oil with its higher flash point its lubricating qualities are af-

fected. In either case, however, too much oil should not be used, as it will increase the carbonization in the cylinders. Some roads, in an endeavor to prevent air getting into the cylinders, have eliminated relief valves and substituted drifting valves with material success. Difficulty with respect to the Ragonnet reversing gear creeping on has in some cases been eliminated by lubricating the cylinder with a mixture of soft grease and graphite.

SCIENTIFIC TRAIN LOADING, TONNAGE RATING

O. S. Beyer, Jr. (Chicago, Rock Island & Pacific), presented a paper on scientific train loading, of which the following is an abstract:

Scientific train loading or tonnage rating takes into consideration, as far as may possibly be determined, every element affecting the economical movement of freight trains. These elements may be summarized as follows: Drawbar pull of locomotive; resistance of freight cars of all weights; grades; curves; condition of track; temperature, weather and wind; opposing traffic; length of division, and speed.

The object of a scientific tonnage rating system primarily is to give an engine the same amount of work to do regardless of whether a train is made up of heavy cars or light cars, or a mixture of them. Its further object is to load engines at all times in accordance with conditions of weather, temperature, wind, track, etc., so that freight will always be handled for the least expense possible per ton-mile.

The most scientific and simple system yet devised is the adjusted tonnage rating system. This system, when carried out to its logical conclusion, as its name implies, endeavors to adjust the loads of freight trains as exactly as possible to suit the conditions existing. In order to understand how the adjusted tonnage rating system accomplishes this object, its development for a division and application will be described.

The first element to be considered is the drawbar capacity of the locomotive used in hauling freight trains over the division, in conjunction, of course, with the grades and curves of the division and the desired speed of the train over the division. The sustained drawbar pull of an engine equals the sustained theoretical tractive effort of the engine less the effort of the engine lost to move itself and tender. The sustained theoretical tractive effort of the locomotive at a speed above 7 to 10 m.p.h. depends on the speed of the pistons at these higher speeds and the capacity of the boiler to furnish steam. This tractive effort, for a saturated or a superheated steam locomotive, is secured by the aid of the figures shown in Table I—first by calculating the piston speed of an engine in feet per minute at the speed at which the engine is to run over the ruling grade and then referring to Table I to determine what speed factor corresponds to the piston speed calculated. The product of the maximum theoretical tractive effort when multiplied by the speed factor will be the sustained tractive effort of the engine at the speed considered.

TABLE I

Speed Factors for Saturated Superheated Steam Locomotives at Various Piston Speeds

Piston Speeds Ft. per Min.	Speed Factor Saturated	Speed Factor Superheated
100	1.000	1.000
200	1.000	1.000
300	.954	.954
400	.863	.863
500	.772	.772
600	.680	.682
700	.590	.605
800	.517	.542
900	.460	.490
1,000	.412	.445
1,100	.372	.405
1,200	.337	.371
1,300	.307	.342
1,400	.283	.318
1,500	.261	.297

Next, it is necessary to make allowance for the power lost by the engine moving itself. This depends principally upon the weight of the engine in tons. The power lost by the engine lifting itself up grade is equal to twenty times the total weight of the engine in tons times the grade in per cent. The power lost by the engine moving itself, i. e., rolling its own wheels on the rails, may be divided into three subdivisions:

Resistance of drivers in pounds—
22.2 lb. times weight on drivers in tons.
Resistance of trucks in pounds—
6 lb. times weight on trucks.
Resistance of tender in pounds—
Resistance per ton of tender (see Table II) times weight of tender in tons.

If the locomotive is obliged to traverse a curve, then a further deduction of one pound per ton of locomotive per degree of curve should be made. Inasmuch as very high speeds do not enter into the consideration, it is not necessary to make allowance for air resistance to the locomotive.

All those various resistances, namely, that due to grade, drivers, engine trucks, tender, and curvature, are then added together and subtracted from the sustained tractive effort which the engine is capable of maintaining at the speed at which it is to negotiate the ruling grade. Mathematically the foregoing statement may be expressed in the following formula:

$$\text{S. D. B.} = \frac{.8\ F\ P\ d^2\ S}{D} - W_G\ (20g + 1\ C) - 22.2\ W_D - 6\ W_T - r_e\ T,$$

in which S. D. B. represents sustainable drawbar pull of engine in lbs.

F — Speed factor of engine running at speed under consideration as determined from Table I.
P — Maximum boiler pressure of engine in lb. per sq. in.
d — Diameter of engine cylinders in inches.
S — Stroke of engine cylinders in inches.
D — Diameter of engine driver in inches.
W_G — Total weight of engine and tender, fully loaded, in tons.
g — Per cent of grade.
W_D — Weight in tons of engine on drivers.
W_T — Weight in tons of engine on trucks.
T — Weight of tender in tons, fully loaded.
r_e — Resistance in pounds per ton of engine tender considered as a car (determined from Table II).
C — Degree of curvature.

RESISTANCE OF TRAIN

Having found the drawbar pull the engine will sustain negotiating the ruling grade, it next becomes necessary to determine the weight of train this amount of drawbar pull will move up the grade at the speed desired. The resistance of a freight train depends directly on weight of the train, average weight of cars composing train, grade, curvature, speed at which train is required to move up grade, temperature, and wind.

Train resistance may be classified, generally speaking, under two heads: Internal resistance and external resistance.

The internal resistance of a freight train is that resistance which arises principally from the friction of the car journals, the rolling of the wheels on the rails, the friction of the wheel flanges on the rails, friction at side bearings, etc.

The external resistance of a freight train is that which arises from sources outside of the train itself and is principally composed of the resistance due to grade, wind and curvature.

Internal Resistance of Freight Trains.—The internal resistance of a freight train, or, more simply speaking, of a freight car, does not vary directly in proportion to the weight of the car in tons. For this reason an engine can haul more tonnage in heavily loaded cars than in light or empty cars. And so in loading freight trains, the adjusted tonnage rating system recognizes this feature and makes it possible to load each engine with tonnage according to the number of light or heavy or both kinds of cars composing the train. By referring to Table II it will be noted exactly how the internal resistance varies per ton of cars weighing 15 to 75 tons for different speeds.

The temperature of the atmosphere and the condition of the track affect this internal resistance. As the temperature decreases, or when the condition of the track is poor, the internal resistance is greater. Consequently, when determining the proper tonnage for an engine, these facts must be taken into consideration largely according to judgment. The figures given in Table II have been determined by a long series of tests at summer temperature on track which was in very good shape. Hence these figures should be used when determining the maximum train loads possible under ideal conditions.

External Resistance of Freight Trains.—The external resistance of freight trains or cars arises, as pointed out previously, from grade, curvature and wind. The grade resistance of freight cars is the same as that of locomotives, equaling per ton of car 20 times the per cent of grade. Curve resistance also is determined the same as curve resistance for locomotives. For purposes of tonnage rating under average conditions, an allowance of one pound resistance per ton of car for each degree of curvature has been found very nearly correct.

Wind resistance to freight cars is a variable quantity under usual railway operating conditions. Its effect is best determined as a matter of judgment in the use of the various classes of ratings established (to be described later) according to the actual conditions existing.

TABLE II

Value of Internal Resistance in Pounds per Ton Gross Weight of Freight Cars of Various Weights at Different Speeds

Weight of cars in tons	Pounds of Resistance per Ton of Car at Speed of			
	5 m.p.h.	10 m. p h.	15 m.p.h.	20 m.p.h.
15	7.62	8.19	8.82	9.56
20	6.77	7.29	7.88	8.53
25	6.02	5.50	7.01	7.60
30	5.38	5.80	6.28	6.82
35	4.82	5.20	5.64	6.11
40	4.39	4.69	5.06	5.50
45	4.01	4.28	4.60	5.00
50	3.72	3.96	4.24	4.60
55	3.49	3.69	3.94	4.27
60	3.30	3.49	3.73	4.04
65	3.16	3.34	3.57	3.88
70	3.05	3.24	3.48	3.79
75	3.00	3.18	3.41	3.71

External resistance is not affected by weather or temperature and does not vary practically except in direct proportion to the weight of the train. The length of the train has a little to do with curve resistance and wind resistance, but this influence on the whole resistance is too remote to be determined accurately.

The total resistance of a freight train per ton of car weight, as explained in the foregoing, may be summarized and expressed by the following formula:

$$R = Vc + 20\,g + 1\,C.$$

in which R represents total resistance in pounds per ton of freight car Vc represents internal or rolling resistance per ton of freight car, depending upon weight of freight car, as determined from Table II at speed under consideration; g represents grade, expressed in per cent and C represents degree of curvature.

DETERMINATION OF TRAIN WEIGHTS

The weight of train in tons which may be moved at a certain speed over a certain grade and curve is found by dividing the sustainable drawbar pull in pounds of the engine by the total resistance per ton of car. Mathematically expressed, this statement takes the following form:

$$\text{Weight of Train in Tons} = \frac{\frac{.8\,F\,P\,d^2S}{D} - W_G\,(20\,g + 1\,C) - 22.2\,W_D - 6\,W_T - {}_e\,T}{V_c + 20\,g + 1\,C}$$

In order to demonstrate just how the hauling capacity of a locomotive varies according to the different weight cars making up the train, the following example will be of interest:

Consolidation locomotive.....40,000 lb. maximum tractive effort
Grade.....0.3 per cent
Average weight of light cars.....20 tons
Average weight of heavy cars.....70 tons
Speed of train up grade.....10 m.p.h.

The sustainable drawbar pull of the engine at 10 m.p.h. on straight and level track, as determined by the method described, is 35,300 lb. Deducting for grade resistance on a 0.3 per cent grade, this sustainable drawbar pull becomes 34,220 lb.

The resistances per ton of a 20-ton and a 70-ton car at 10 m.p.h. going up a 0.3 per cent grade are as follows:

For a 20-ton car—
Internal resistance (see Table II).....7.29 lb.
Grade resistance (.3 × 20).....6.00 lb.
Total resistance .....13.29 lb.
For a 70-ton car—
Internal resistance .....3.24 lb.
Grade resistance (.3 × 20).....6.00 lb.
Total resistance.....9.24 lb.

Consequently the tonnages and number of cars which, under most ideal conditions, this 40,000-lb. tractive effort Consolidation locomotive can pull over a 0.3 per cent grade at 10 m.p.h. in 20-ton cars (all lights or empties) and in 70-ton cars (all heavies or loads) are respectively:

In 20-ton cars, i. e., lights or empties—
Weight of train..... $\frac{34,220}{13.29}$ = 2,575 tons.
Number of cars..... $\frac{2,575}{20}$ = 129 cars.
In 70-ton cars, i. e., heavies or loads—
Weight of train..... $\frac{34,220}{9.24}$ = 3,706 tons.
Number of cars..... $\frac{3,706}{70}$ = 53 cars.

Thus it is seen that on a 0.3 per cent grade a 40,000-lb. tractive effort locomotive can pull 1,131 more tons in trains consisting of 70-ton cars than it can pull in trains consisting of 20-ton cars. When this fact is fully appreciated, the advantage of adjusting the tonnage of trains according to the average weight of all the cars making up the train is completely realized.

The more steep the grade becomes the less the difference in tonnages between the light car trains and heavy car trains. This is accounted for by the fact that as the grade increases the grade resistance, which is constant per ton for all cars, heavy or light, becomes a greater proportion of the total resistance and the rolling or internal resistance, which varies per ton inversely as the weight of the car varies, becomes less in proportion to the total resistance. This is another important fact and should be fully grasped so that it will be clearly understood why the adjustment for difference in car weights decreases as the ruling grade increases.

CAR FACTOR METHOD OF TONNAGE ADJUSTMENT

Having determined, as far as possible, the hauling capacity of a locomotive or class of locomotives over a division, after taking into consideration mathematically all the items which affect the problem, namely, train speed, grade, theoretical drawbar pull of engine, average car weights, curvature, etc., the final problem remains to find the best method of making up trains in the yard so that their tonnage will be equalized or adjusted to suit the hauling capacity of the locomotive. The best method by which this end is reached is the car factor method of adjustment.

This method simply provides for the addition of a purely imaginary figure, known as the car factor, to the actual weight of each car, including the caboose, entering into the make-up of a train until the sum of all the actual car weights plus their car factors equals the adjusted tonnage rating over the division of the locomotive to be loaded or rated. Knowing what actual tonnages and how many cars an engine or class of engines may pull over the grades of a division both in light or empty cars and in heavy or loaded cars, as determined mathematically by the process previously explained, it becomes a very simple matter to establish the car factor and the adjusted tonnage rating for the engine and division under consideration. The car factor equals the difference in the tonnages of the heaviest car train and the lighest car train the engine can haul, divided by the difference in the number of cars between the heaviest and lightest car trains. The adjusted tonnage for the engine equals the sum of the actual tonnage of the lightest car train and the number of cars in this train multiplied by the car factor, or, which is the same thing, the sum of actual tonnage of the heaviest car train and the number of cars in this train multiplied by the car factor. To illustrate, take the figures of tonnages and number of cars determined as the hauling capacity of a 40,000-lb. tractive effort Consolidation locomotive on a 0.3 per cent grade:

Weight of 70-ton car train.....3,706 tons
Weight of 20-ton car train.....2,575 tons
Difference in tonnages.....1,131 tons
Number of cars, 20-ton car train..... 129
Number of cars, 70-ton car train..... 53
Difference in number of cars..... 76

Hence car factor on 0.3 per cent grade..... $\frac{1,131}{76} = 15$

And so the adjusted tonnage for 40,000-lb tractive effort

engine under ideal conditions on 0.3 per cent grade, engine moving at 10 m.p.h., equals:

$2{,}575 + (129 \times 15)$.....4,510 adjusted tons.

Or, which is practically the same thing:

$3{,}706 + (53 \times 15)$.....4,501 adjusted tons.

This same theoretical analysis applies to any condition of grades and size of locomotive involved. If carried out for all grades varying from 0 to 2 per cent the car factors applying to each grade will be found as per Table III:

TABLE III

Car Factor for Different Grades

Grades in Per Cent	Car Factor
0.0	70
.1	31
.2	20
.3	15
.4	12
.5	10
.6	8
.7	7
.8	6.5
.9	5.5
1.0	5
1.25	4
1.50	3.5
1.75	3.0
2.00	2.8

Thus it is seen that the heavier the grade becomes, the less the car factor grows, while, of course, at the same time the less the adjusted tonnage rating becomes.

The significant fact to be gained from the method of tonnage adjustment is that the actual weight of trains varies indirectly in proportion to the number of cars composing the train, and directly in accordance with the average weight of all cars composing the train. This is more graphically illustrated by Table IV, which is based on the figures developed for the adjusted

TABLE IV

How Train Tonnage Varies for Different Average Car Weights Considering a 40,000-lb. T. E. Locomotive on a 0.3% grade; Adjusted Tonnage, 4,500; Car Factor, 15

Average Car Weights in Tons	Actual Weight of Train in Tons	Number of Cars Composing Train
20	2,565	129
30	3,000	100
40	3,270	82
50	3,465	69
60	3,600	60
70	3,705	53

tonnage rating of a 40,000-lb. tractive effort. Consolidation locomotive on a 0.3 per cent grade.

REDUCTIONS FOR WEATHER AND OTHER CONDITIONS

Having determined theoretically and verified practically by previous locomotive performance records, special tonnage tests and dynamometer car runs, if possible, the maximum adjusted tonnage which can be hauled over a division, it finally becomes necessary to establish certain reduced ratings to guard against weather and other conditions which make reduced ratings necessary. It has been found most practical to provide four ratings for each class of engine between principal yard points or division terminals. These four ratings may best be designated by the letters *A, B, C* and *D;* the *A* rating being the maximum and the *B, C* and *D* ratings reductions from the maximum or *A* rating according to certain percentages dependent on the ruling grades.

Inasmuch as the temperature has the greatest influence on the resistance of trains, and hence the hauling capacity of locomotives, this is used as the basis on which to reduce the tonnage of trains from the maximum rating. Primarily a reduction in temperature only affects the internal resistance of trains, increasing it as the temperature drops. Consequently, the greater the proportion of internal resistance of a train, the greater is the effect of a reduction in temperature on the resistance of the train. In other words, the lower the ruling grade, the greater the proportional allowance must be from the maximum or *A* rating for a reduction in temperature.

What the exact allowance is that should be made for certain reductions in temperature under all conditions has never been proven exactly by experiment, and in reality hardly can be proven very accurately. Experience, however, determined in the light of reason, has shown the following temperature variations to be satisfactory upon which to base reductions in tonnage from the maximum when making up trains:

Maximum rating—Temperature above 40 deg. F.
First reduction—Temperature below 40 and above 20 deg.
Second reduction—Temperature below 20 deg. and above zero.
Third reduction—All temperatures below zero.

For purposes of simplicity these various ratings may be designated as *A* or maximum and *B, C* and *D* respectively. Table V is given to show what has been found, in practice, to be satisfactory working reductions for temperature changes, based on increasing grades. It should be noted that as the grade increases,

TABLE V

Reductions in Per Cent to be Made From the Maximum or "A" Adjusted Rating for Decreases in Temperature

Grade in Per Cent	Reductions in Per Cent from Maximum or "A" Adjusted Ratings			
	Above 40°	40° to 20°	20° to 0°	Below 0°
0.0	0	13.70	27.40	41.10
.1	0	11.20	22.40	33.60
.2	0	9.70	19.40	29.10
.3	0	8.70	17.40	26.10
.4	0	7.98	15.96	23.40
.5	0	7.45	14.90	22.35
.6	0	7.00	14.00	21.00
.7	0	6.70	13.40	20.10
.8	0	6.42	12.84	19.24
.9	0	6.20	12.40	18.60
1.0	0	6.00	12.00	18.00
1.25	0	5.63	11.26	16.89
1.50	0	5.37	10.74	16.11
1.75	0	5.20	10.40	15.60
2.00	0	5.00	10.00	15.00

the amount of reductions from the heaviest rating grows less and less. The reason for this has been pointed out before and is sound logic, borne out by experience.

PRACTICAL CONSIDERATIONS IN DETERMINING MAXIMUM ADJUSTED TONNAGE RATING

Inasmuch as the maximum or *A* adjusted tonnage rating for an engine is the rating from which all the others are determined —that is, forms the basis for the ratings over a division—it is quite essential that this be established as nearly accurate as possible. It will most always be found, however, that the highest rating which is considered possible by mathematical calculation is either too high (most usually too high) or too low for practical purposes. Consequently, after the theoretical determinations have been made, they should always be fully tested out by actual tonnage tests under practical conditions. If the service of a dynamometer car can be had for this purpose it will assist materially toward proving the accuracy of the calculation.

The element of train speed, necessity to get from terminal to terminal in a certain time to get the greatest number of ton-miles per year out of an engine, is another very important practical consideration. It is difficult to determine generally what the most economical speed is at which trains should move over the division. To establish this speed and demand that it be lived up to at all times is a mistake, for the many conditions on a division which affect it are changing continually. It has been found by experience that the provision of four ratings, *A, B, C* and *D,* gives the division superintendent or division chief despatcher a sufficient number of ratings from which to choose for each day or each train, if necessary, in order to move the business best to suit the many influences which bear on this problem. And if the ratings are not sufficient, then special ones may quickly be established, according to the judgment of the official in authority, in order to meet special or emergency conditions.

The following brief explanations and instructions have been used with success by the author when he has had occasion to introduce the adjusted tonnage rating system on a railroad. They are repeated here by way of illustration:

The following two important facts and their effect on freight train operating economies will be appreciated from a study of the adjusted tonnage rating system. The first is the benefit resulting from making up trains so as to get as many loaded or heavy cars as possible into each one and thereby avoid running trains composed entirely of empty or light cars. This arrangement will often prevent the running of trains on which tonnage has had to be sacrificed on account of having reached the car limit before the train was filled out to the maximum adjusted tonnage.

The other fact which should be realized is the necessity of getting actual car and thus train weights as accurate as possible. The entire benefit from the adjusted tonnage rating system will be lost unless great care is taken in determining the actual car and train weights. To this end such means and systems at yard offices and at stations where cars originate for shipment should be introduced which will result in the greatest possible accuracy in determining actual car and train weights.

INSTRUCTIONS

(1) All ratings are based on tons.

(2) To determine the proper tonnage for an engine, find first from the rating tables the adjusted tonnage in effect corresponding to the engine. Then add the car factor to the actual weight in tons of each car. Finally, add together the weights of all cars plus their car factor allowance until the total equals the adjusted rating in effect.

(3) To determine the proper tonnage for a pusher, double header, or three or more engine train, add together the adjusted ratings in effect for each one of the engines in question and proceed as outlined in paragraph 2.

(4) When rating an engine, yardmasters and conductors will consider the caboose as one of the cars of the train, adding the

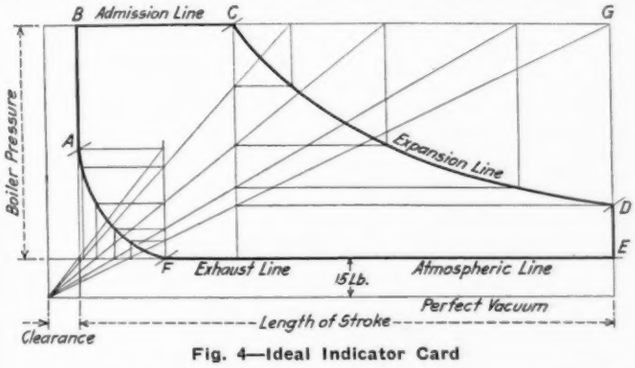


Fig. 4—Ideal Indicator Card

car factor to the actual weight in tons of the caboose and this to the adjusted tonnage of the balance of the train, the total to equal the adjusted rating in effect, as outlined in paragraph 2.

(5) When dead engines are hauled in a train yardmasters and conductors will add four times the car factor to the actual weight of each dead engine, and this to the adjusted tonnage of the balance of the train, the total to equal the adjusted rating in effect, as outlined in paragraph 2.

(6) Yardmasters and conductors will add another light car to the train when the total adjusted tonnage of the train, including the caboose, adds up fifteen or more adjusted tons (that is a fraction of a car) less than the adjusted rating in effect.

(7) Despatchers, yardmasters and conductors will place as many loaded or heavy cars as possible in every train and avoid running any trains consisting entirely of empty cars unless otherwise instructed.

(8) All classified freight trains as well as ordinary freight trains will be rated strictly on the adjusted tonnage basis.

(9) No reductions in tonnage on account of weather or other conditions are to be made unless authorized by the superintendent.

(10) Actual weights of empty or loaded cars must not be estimated or assumed when they are available from the car stencils or the way-bills.

(11) When actual weights cannot be determined, the following estimates for weight of contents and light weights of cars are to be used, but not otherwise. Contents are to be estimated at the marked capacity of the car, except in case of light commodities, such as hay, cotton or bran, in which case the contents should be estimated at one-half the marked capacity. In the case of way freight (merchandise) cars, five tons will be used as the weight of the contents.

Light weights of cars to be estimated as follows:

Kind and Capacity of Cars	Light Weight (in Tons)
Box 40 ft., 80,000 lb. capacity	19
Box 34 ft. and 36 ft., 60,000 lb. capacity	16
Box 34 ft., 40,000 lb. capacity	13
Box 25 ft., 40,000 lb. capacity	10
Furniture 40 ft.	18
Furniture 50 ft.	21
Refrigerator	18
Refrigerator (meat)	21
Stock 30 ft., 30,000 lb. capacity	10
Stock 36 ft., 40,000 lb. capacity	11
Stock 36 ft., 60,000 lb. capacity	16
Double-deck stock	16
Plain flat 30 ft.	8
Plain flat 34 ft.	12
Plain flat 40 ft.	14
Plain flat 43 ft.	17
Coal cars 34 ft.	13
Coal cars 36 ft.	16
Hopper bottom coal, 80,000 lb. capacity	18
Hopper bottom coal, 100,000 lb. capacity	21
Rodger ballast cars	16
Ingoldsby dump cars	18
Tank cars	14
Cabooses	15

(12) When converting the actual weights of cars from pounds into tons by dividing the actual weights in pounds by 2,000, yardmasters and conductors will in all cases neglect a remainder of 999 pounds or less, but will consider a remainder of 1,000 lb. or more as one ton.

DISCUSSION

The discussion was opened by J. M. Daly, formerly general superintendent of transportation of the Illinois Central, and an expert on tonnage rating, who spoke very highly of Mr. Beyer's paper. He believed that if in making up trains this system of adjusted tonnage were followed large economies in transportation costs would be made. He called particular attention to the fact that the resistance per ton of the loaded car is much less than that of the empty car. This of itself should justify the use of the adjusted tonnage rating system. He mentioned one road that had made a saving of 5 per cent by adopting this system. Overloading was considered more expensive than underloading.

Several members had found by experience that the short trains with the heavy loads hauled much easier than the long trains of light cars, even though the actual tonnage was much greater. It was generally believed that while a dynamometer car was of considerable advantage in determining the rating of a locomotive the work can be very satisfactorily performed by men experienced in the performance of locomotives and in this case the weight of the train should be carefully determined.

In helper service it is found to be much better practice to place the assisting locomotive at the rear of the train, especially if the grades are undulating and the curves are sharp. Mention was made by Prof. L. E. Endsley of the increase in train resistance due to badly worn wheel treads and lose trucks, the former being found, by test, to increase the resistance as much as 100 per cent. He also mentioned the necessity of keeping the wheel tires to the proper contour, stating that experiments have shown that wheels with no taper on the tread have materially increased the resistance of trains. Mention was also made of the fact that with the side bearings binding on loose trucks the wheels bind on the rails for some distance after passing a curve.

EFFECT OF VALVE GEAR ON LOCOMOTIVE OPERATION

W. E. Preston, Southern Railway, presented an interesting paper on this subject, in which he said in part:

In order to more readily explain any defects in a locomotive valve gear, as disclosed by the indicator, we will begin by examining the ideal indicator card, and for the sake of clearness we will first briefly outline this card for a non-condensing reciprocating stationary steam engine. Such a card is shown by the line in Fig. 4, indicated by the letters *A, B, C, D, E, F* to *A*. The construction is practically self-explanatory, the card being laid out to scale to represent the dimensions shown. Any cut-off may be chosen. Conditions applying to a locomotive require us to modify the ideal card outlined above in many respects. The valve gears are driven by an eccentric or its equivalent, the return crank—hence the functions of the valve are more or less

gradual and entirely interdependent on each other. There are also other influences besides the valve gear that materially affect the contour of an indicator card taken from the locomotive, the flow of steam being more or less impeded. We have, therefore, for the locomotive a card similar to Fig. 5.

Owing to the restrictions of the steam passages the pressure in the cylinder at admission will not be equal to the boiler pressure. The pressure during the portion of the stroke represented by *BC* will not be uniform for two principal reasons. The steam ports are, even when fully open, necessarily of limited area. At the beginning of the stroke the piston is moving comparatively slowly, while the valve, on the contrary, is at the quickest portion of the stroke, and is rapidly uncovering the port, and steam pressure is consequently at first fairly well maintained. As the point of cut-off is approached, the piston is, however, moving nearly at its maximum velocity, while the port is

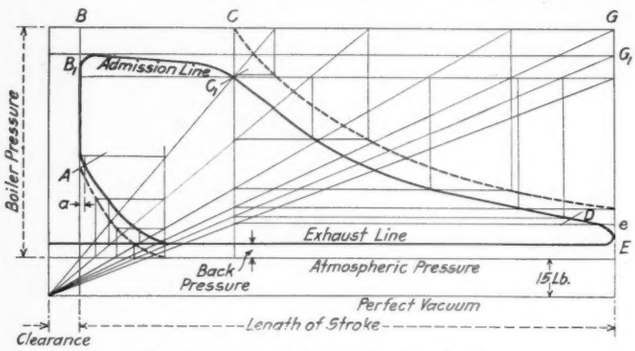


Fig. 5—Locomotive Indicator Card

being gradually closed by the valve, and the area available for admission of steam is gradually diminished. As a result the steam cannot enter fast enough to follow up the piston. It is, in fact, throttled at its entrance to the cylinder, and the pressure falls in consequence, so that the line B_1 C_1 is no longer horizontal (for steam worked expansively), but drops as represented by the line indicated by the letters *A, B, C, D, E* to *A*.

Another cause of loss of pressure at the commencement of the stroke when the steam is worked expansively is the partial condensation of the entering steam, which takes place as it comes in contact with the sides of the port and walls of the cylinder, which have been previously cooled down by contact with the exhaust steam of the preceding stroke. It is sought to minimize this loss by keeping the cylinder hot by surrounding it with a jacket, by using superheat steam, etc.

The point of cut-off *C* instead of being sharply defined, as in Fig. 4, is usually rounded as at C_1 in Fig. 5. This results from the very gradual manner in which the slide valve cuts off the steam, causing wiredrawing and fall of pressure at this point.

The actual curve of expansion of steam in the ordinary conditions of working of an engine is most complex, being, in fact, the resultant of a series of opposing condensations and re-evaporations. The final form of the curve for a given ratio of expansion is determined by the amount of clearance, by the dryness of the steam and the efficiency of the jacketing.

The exhaust is generally opened a little before the end of the stroke in order to allow the exhaust steam plenty of time to get away before the new stroke commences and in order to allow the port being pretty well opened at the end of the stroke.

The result is that the expansion curve terminates at a point *D*, Fig. 5, and is succeeded by a rounded corner which is caused by the exhaust being throttled at first by the smallness of the aperture of the port when it commences to open. As the whole of the exhaust steam will probably not have escaped by the end of the stroke, instead of having the vertical line at *E* bounding the end of the diagram, we shall have a curved line.

The exhaust curve is different for each cut-off used, for as the point of cut-off on a locomotive varies, so does the point of exhaust opening—the earlier the one, the earlier the other, etc. This is quite an advantageous feature, as at high speeds the engine is worked with a short cut-off and the exhaust needs to be opened earlier in order to allow time enough to expel the steam during the quick movement of the valve. The point of exhaust opening even for slow speed and steam worked full stroke can never be quite at the line *GE*, Fig. 5. Hence the cut-off can never be 100 per cent. It is seldom over 85 per cent.

A locomotive has to have some back pressure to create the draft. In addition to this, there will be an increment of pressure due to the difficulty of expelling the steam from the cylinder through the ports and exhaust passages. Of course, the greater the back pressure, the greater the loss of efficiency of the engine, and excessive back pressure causes a very serious loss of efficiency which is readily noticeable in the amount of fuel used.

The amount of compression varies with the cut-off. The admission line begins usually at such a point as *A*, Fig. 5, in order to allow the admission port to be slightly open at the beginning of the stroke. Thus, *a*, Fig. 5, represents the lead.

The amount of Coal Used.—The amount of soal used is, of course, directly proportional to the amount of steam used, so that if we find the amount of steam used per horsepower hour as represented by any indicator card, we have a measure of the amount of coal used in doing the work represented by this card. Not all the steam generated in the boiler of a locomotive is used in the cylinders, neither is all the steam that is turned into the cylinders used in producing actual work, for a percentage of this steam is condensed in the cylinders and thus wasted. These losses are entirely immaterial to the comparison of different cards, as obviously it is fair to assume that with the same cut-off and speed the losses are the same for the two cards compared.

The indicated horsepower of a locomotive is represented by the following formula:

$$\text{Horsepower} = \frac{M \times d \times d \times L \times S}{375\ D} \quad \ldots\ldots\ldots\ldots (a)$$

M = mean effective pressure as obtained from indicator card.
d = diameter of cylinder in inches.
L = length of stroke in inches.
S = speed in miles per hour.
D = diameter of drivers in inches.

If it is desired to turn this into tractive power, we may readily do so. The ordinary well-known formula for tractive power is:

$$\text{Tractive power} = \frac{M \times d \times d \times L}{D} \quad \ldots\ldots\ldots\ldots (b)$$

The following formula gives the pounds of steam used per hour (for constant speed):

$$\text{Pounds of steam per hour} = \frac{36.66 \times S \times W}{3.1416 \times D} \times (3.1416 \times d \times d \times f \times L + 4 \times C) \quad \ldots\ldots\ldots\ldots (c)$$

S = speed in miles per hour.
W = weight in pounds of a cubic foot of steam at pressure considered.
f = fraction of stroke piston stands at for pressure considered.
D = diameter of drivers in inches.
d = diameter of cylinders in inches.
C = volume of clearance space in cubic inches.
L = length of stroke in inches.

The pressure is taken from the indicator card at any point on the expansion line after cut-off has taken place and before the

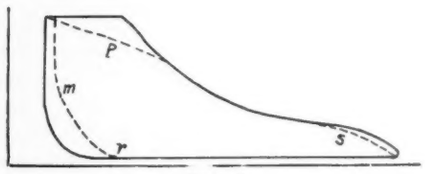


Fig. 6

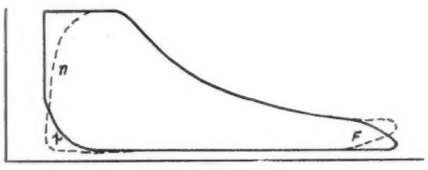


Fig. 7

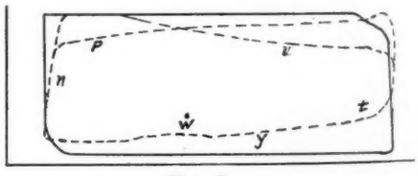


Fig. 8

exhaust has begun to open, as the steam is completely bottled up in the cylinder during this part of the stroke.

Distorted Indicator Cards.—There are many things that go to distort an indicator card, but a defect in the valve gear, or the setting of the valve gear, will at once become evident in the indicator card.

Figs. 6, 7 and 8 illustrate some of the defects due to faulty valve gear.

P = Wiredrawing.
m = Too much lead.
r = Too early exhaust closure.
s = Too early exhaust opening.
x = Insufficient compression.
n = Not enough lead.
t = Late exhaust.
u = Loose motion and wiredrawing.
P = Lack of lap.
y = Excess back pressure due to late exhaust.
w = Blow.

These are the common defects due to the valve motion. Other defects, such as excess condensation, restricted ports, leaky valves, etc., are shown by the indicator card, but as these are not the fault of the valve motion they have no place here.

The card shown in Fig. 9 was taken from an actual test on a Consolidation engine having a Stephenson valve gear. It is a corner card, but the cut-off on this engine measured 87.5 per cent, whereas it should have been 85 per cent if properly set. The result of over-travel of the valve is clearly seen in the very late exhaust and lack of lead. From this card it is determined that 14.5 per cent more coal was being used than necessary at this point of cut-off. Moreover, the distorted motion reduces the maximum tractive effort of the engine some 3,000 lb.

Fig. 10 shows another card from the same engine hooked up to the sixth notch. Here the cut-off measured 73 per cent on the engine, while for this notch the ideal card gives 69 per cent. The straight line is the ideal card, the bent line showing the actual card. The valve still lacks lead and has too late exhaust opening, but the back pressure drops to normal at the admission

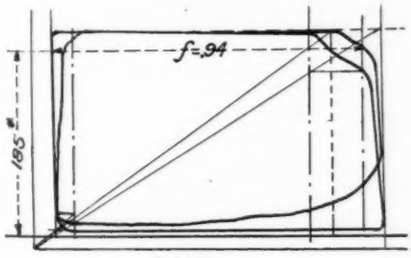


Fig. 9

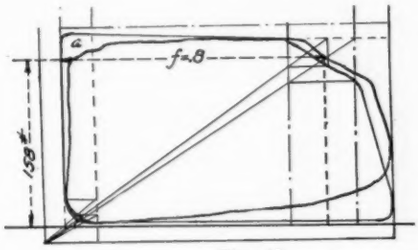


Fig. 10

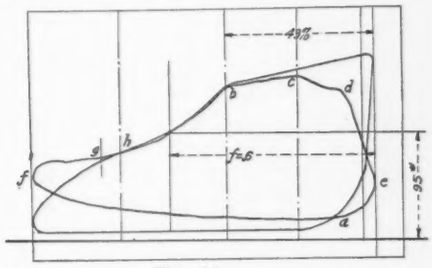


Fig. 11

end of the card. The effect of the slack in the valve motion is clearly shown at *a*. After the port gets fully open there seems to be very little throttling effect. This also applies to Fig. 9. Hence the port openings are ample.

The mean effective pressure for the ideal card is 167 lb., while for the actual card it is 156 lb., the increase in cut-off not being quite enough to compensate for the effect of late admission and exhaust. In this case there is 11.4 per cent more coal being burned than necessary to develop the same horsepower, the tractive effort being reduced 2,800 lb.

As the lead increases as the reverse lever is hooked back toward the center of the quadrant, we would expect the card of Fig. 10 to be better than that of Fig. 9. All of the events being earlier, the earlier release somewhat reduces the back pressure.

Theoretically the back pressure line should be parallel to the atmospheric line, and about the same distance from it for all cut-offs. At high speeds and short cut-offs, of course, more exhausts take place per minute than at slow speed, but to offset this we have a very much less volume of steam exhausted per stroke at high speed than at low speed. Practically, it is found that the back pressure increases slightly as the speed increases, the amount of condensation not being exactly constant at all speeds. However, the back pressure should not be greater than 10 lb. at 20 m.p.h., or 15 lb. at 50 m.p.h., according to the best authorities.

As another example of a very poor card Fig. 11 is shown. This card is a very common one for valves poorly set. The line *ed* shows a lack of lead, the line *dc* shows the wiredrawing and slack motion effect of the valve in opening the steam port, while *cb* shows this effect for the closing of this port or at cut-off. The cut-off and expansion are normal, while *gf* shows a late and restricted exhaust, and *fa* shows that the exhaust port does not get fully open until the piston is at *a* on its return stroke—hence the high back pressure and resulting small compression.

As the expansion line for the length *bh* is the same for the good and bad cards, the amount of steam and coal used is, of course, the same for both cards. The coal consumption per horsepower hour, however, is increased 14.5 per cent.

DISCUSSION

From a fuel economy standpoint there seemed to be no preference between the Stephenson and any of the outside gears. It was the general opinion that the maintenance and accessibility of the outside gears, however, was much in their favor. Considerable was said concerning breakdowns to the motion work of the outside gear engines, and while some advocated completely cutting out the side of the engine affected, by removing the eccentric rod and the connecting link at the bottom of the lap and lead lever, others believed that better results would be obtained if it were possible to retain the motion to the valve derived from the crosshead, claiming that if the engine got on dead center this would materially aid in making a start. Some members advocated not clamping the valve in its mid position, claiming that as soon as the steam was admitted to the steam chest the valve would automatically center itself, and in case an engine stopped on center it could be moved over sufficiently to admit steam to the lame side, permitting the engine to start, the valve recentering itself after the first revolution.

ELECTRO-PNEUMATIC BRAKE

Walter V. Turner, assistant manager and chief engineer of the Westinghouse Air Brake Company, gave an illustrated lecture on the possibilities of the electro-pneumatic brake in the steam railway field. He called attention to the relation of the air brake to the power of the present day locomotive, showing how these powerful engines would be useless without the air brake to control them. The variable load brake has made possible to a still greater degree the heavier trains, the Virginian now operating trains of 8,000 tons with this type of brake. When considering the action of the air brake, the rail, the roadbed, the consist of the train and the foundation gear must all be taken into account, as they all have a definite bearing on how the brake will perform in service.

The piston travel is of prime importance, especially on long trains. It should be constant throughout the length of the train if "rough handling" is to be eliminated. Tests have shown that with an 8-lb. brake pipe reduction at the end of two seconds the cars with the proper piston travel (8 in.) will develop a braking power of 16 per cent, whereas those cars with a 6-in. travel of the piston will develop a braking power of 43 per cent,

which naturally causes very rough handling of the train. On long freight trains light applications should be made. This, of course, will increase the length of stop, but smooth handling will result. It should be remembered that the brake is four times as effective at 10 m.p.h. as at 20 m.p.h. and therefore the brake pipe reductions will have to be governed accordingly in making smooth stops.

In speaking of the clasp brake, he gave as a rough and ready rule as to when this brake should be used, the condition where the side pressure of the shoe exceeds the downward pressure of the wheel.

The purpose of the electrically-operated brake is wholly and solely to permit the use of a more efficient air brake. With the electrical control it is possible to have the brakes on all the cars in the train operate simultaneously rather than consecutively, as in the brakes controlled by the reduction of pressure in the train line; because of this feature the surging or the running in of slack, with its attendant disastrous results, will be eliminated and, at the same time, it will be possible to make use of a greater retarding force, thus materially decreasing the length of stop. Experiments have shown that the retarding force can be built up to 20 per cent with the electrically-operated brake, whereas the best pneumatic brake will permit of only 8 per cent retarding force—good train operation being obtained in both cases.

At the present time the electro-pneumatic brake is only available for passenger trains with electrical equipment. The amount of current required for the operation of this brake practically prevents its being used on freight cars in long trains.

Mr. Turner showed various diagrammatical illustrations of the electro-pneumatic brake and pointed out the versatility of the entire system. As many and as small applications of the brake can be made as desired, and the entire system can be recharged with the brakes set. The danger of "stuck brakes" is eliminated, the service and quick-action parts being entirely separate from each other. By its use passenger trains hauled by modern locomotives that have taken 18,500 ft. to accelerate to 58 m.p.h. have been stopped in less than 1,000 ft.

TRAINING OF MEN FOR FIREMEN

Nothing will so well repay the time and money spent as the education and development of railway employees in general and of locomotive firemen in particular. The locomotive firemen are using many million dollars' worth of coal, a great precentage of which is wasted through improper methods of firing and indifference to the fact that this coal represents so much money.

It is an admitted fact that the class of men employed as firemen during the past few years has not been up to the desired standard. We believe that the one thing which leads all others in causing lack of interest, and oftentimes real opposition against the railways, is the fact that in most cases the rank and file of the enginemen only know their superior officer through the chairman of the order to which they belong. The men and officials have grown apart until there is a great lack of confidence on both sides. The traveling engineer can be of the greatest help in regaining this lost confidence, if he has the proper backing.

Every company should have a distinct policy regarding the education and development of firemen from the day they are employed until they have passed all examinations to make them full-fledged engineers. This system should be as clean-cut and as vigorously maintained as the best of other operating systems are maintained. The new man should by all means have some special training before starting to fire a modern locomotive with its multitude of special appliances. He should be well grounded in the reasons for doing the work.

The work of educating the firemen should be placed in the hands of a broad-minded man who believes in this work, and is willing to give the best there is in him to it. He should have a practical knowledge of firing a locomotive and should thoroughly understand the burning of coal (or other fuel which may be used) on a locomotive. He should have a general knowledge of all fuel used on the road and how it should be fired. He should have the knack of imparting his ideas to others on the locomotive or in class talks at terminals. Then, last, but not least, he should have the confidence of the officers of the road and be given full charge of the work, so that there will be no interference from any source.

Lesson papers should be prepared covering a course in elementary combustion, standard firing practice, boiler feeding, care of firebox on the road and at terminals, use of special equipment on the locomotive, rules and signals, instruction in safety first and locomotive-running and breakdowns. Class instruction should be given at the different terminals. The class-room should be fitted with a portable moving picture outfit. Several roads now use the moving picture and speak very highly of it as an educational item of great value. A dummy firebox of standard size and shape, equipped with a brick arch so that the conditions will be the same as on the locomotive, should be used for giving practical instruction.

The employing of new men is very important and should be given the attention of some one capable of judging and handling men. We would suggest the type of man wanted as locomotive fireman as one who is twenty-one years old, with a bright, clean-cut appearance. It is necessary that he should have a common school education and be able to assimilate instruction. He should have good habits, and if married, so much the better. Such a man will repay any time spent on him if he has the right spirit. The prospective fireman should be given a position around the roundhouse in some capacity, such as wiper, machinist helper, or on the cinder pit. If there are shops near or at the terminal, the new men can be placed there. With the men in the shops and in the roundhouse we will have them where we can start their education at once. There they will get experience which will be of great value to them after they get on the road as firemen and even after they go running.

When a man is employed he should be given a letter which will outline the position of the company with regard to his future. It will be explained to him that the company intends to educate him along the best lines of standard practice pertaining to his work; that if he will devote his time during working hours and some of his time out of working hours to the best interests of the company, the latter will give him an education in everything pertaining to his work as a fireman and as a future engineer; that the company expects, as a reasonable return, that the man will give, first, loyalty to the company's interest in every way, striving to promote the welfare of the company whenever possible; then, that he will do his work energetically and according to instructions. If these things are kept before the new man from the beginning, always showing him that the company is taking an interest in him, we will be able to combat a great deal of the other influence at work among the men.

By following this system you have picked men to start with. Then the company will have a chance to instill into their minds right thoughts about the position of locomotive fireman, and right thoughts about the position of the company toward the men. They will be ready to fire an engine from the start instead of probably never learning to fire. In the end it will give us a body of firemen on our locomotives who are interested in their work, who know how their work should be done, and who are looking forward to better positions on the road.

The report is signed by L. R. Pyle (M., St. P. & S. S. M.), chairman; J. C. Heyburn (St. L. & S. F.); J. C. McCutcheon (Wabash); J. Fred Jennings (M. C.), and W. H. Davies (Sou. Schools of Railway Science).

DISCUSSION

The members strongly favored some system of education, especially as under the present conditions engineers are not held responsible for the fireman, as was the case years ago. The new men are shifted around from crew to crew for their instructions, and it is necessary, in order to see that they are

properly instructed where no regular system is provided, that the road foreman make it his special duty to oversee their education. The new men should be made to feel that their superior officers are their friends, and all feeling of antagonism should be eliminated at the start. The men should have no occasion to refer to their schedule if they are treated fairly and squarely by their superiors.

In some cases the new men are started in the roundhouse as wipers, and in others they are tried out in switching service. The system of taking the first man that comes along when new firemen are required was believed to be a very poor system. The work should be made attractive, so that when the men are laid off they are always ready to come back. A. G. Kinyon, of the Seaboard Air Line, laid particular stress on the advantages of educating the men in the elementary principals of combustion, and advocated plenty of supervision to go along with the instruction on the road, claiming that the increase in supervision recently made on the Seaboard Air Line has shown a profit of over 2,000 per cent, due to the saving in fuel.

That the men may be properly chosen, applications in many cases are held for as long as six months to ascertain if they are the proper men for the work. B. J. Feeny, of the Illinois Central, spoke strongly in favor of the instruction car with the moving pictures. On that road the new firemen are given a good talk as to the pitfalls for the new men, such as garnisheeing, signing notes, etc., and they are given over to three crews for breaking in. They are then examined on the book of rules and given personal instructions in regard to handling the scoop.

On the Toledo & Ohio Central weekly meetings are held with the general foremen, the road foremen and such enginemen as are at liberty to attend. The condition of the power is considered, and it has been found that by following this practice the power has been materially improved. Fuel, lubrication, etc., are discussed, and in many cases the men request discussions of special subjects.

Mr. Pyle laid particular stress on the necessity of having the co-operation of the superior officers in any system of education. He strongly favored the starting of the instruction before the men are placed on the engine, and believed that if the men are treated fairly there could be no logical reason for the grievance committee to object to any system of education. He quoted from D. R. MacBain's address before the Fuel Association last May, which was printed in the *Railway Age Gazette, Mechanical Edition,* for June, page 271. Both the engineer and fireman should be congenial, in order that the best results may be obtained, and in case of complaints investigations should be made to see if they are well founded. Many times it will be found necessary to rearrange the engine crews. If no favoritism is shown, it will be possible to adhere strictly to the rules, with no complaint from the grievance committee.

SMOKE PREVENTION WITH OIL BURNING LOCOMOTIVES

When using oil as fuel the presence of smoke is as objectionable and expensive as with any other fuel; the causes may be classed under two heads: Condition of engine, and the manner of handling the engine by the crew. The principles of combustion as applied to the coal burner are applicable to the oil burner, as the fuels are very much alike in their chemical composition; however, the method of introduction into the locomotive furnace is entirely different. At first thought it may appear that the liquid fuel offers more advantages favorable to complete combustion than the solid fuel, but this is not proved in practice.

The cause of smoke is always incomplete combustion, due either to insufficient supply of air or a reduction in temperature, and forcing the fire will produce one or both of these conditions. If the draft holes and front end apparatus are of proper size and their adjustment is correct, a good open nozzle can be used. With a clean boiler and a moderate draft the time for combustion and heat conduction through the sheets and tubes to the water is extended and the desired evaporation can be attained without resorting to a high firebox temperature. This condition would mean lower smokebox temperatures and but very little smoke.

The use of too much brick work in the firebox reduces the amount of heating surface, which means a higher firebox temperature will be necessary. The formation of carbon in the firebox causes much smoke and wastes much fuel. Carbon is formed by allowing the oil spray from the burner to strike some object in its path before it reaches the draft holes. Pieces of brick, piles of sand, or waste, if allowed to fall in front of the burner, obstruct the spray and the small globules of oil are reassembled thereon. Combustion at this point is incomplete and carbon forms. If the obstructions are not removed the accumulation of carbon continues until the terminal is reached.

The location of the burner at least 5 or 6 in. above the bottom of the firebox will cause the spray to pass over small objects in the bottom of the firebox and prevent the formation of carbon and smoke. Much smoke is made while firing up engines at terminals, due to the fact that the fire is forced hard. One hour and thirty minutes should be consumed getting the engine hot, and this would result in quite a fuel saving and less smoke.

An engine crew possessing a general knowledge of the principles of oil combustion can by close attention to their duties do much to prevent smoke formation. There is no good reason why an oil-burning engine should be worked any harder to handle a train than a coal burner should, but as the oil burner requires no great physical exertion by the crew, it is often abused.

The report is signed by Martin Whelan, chairman.

DISCUSSION

While it was believed that smokeless firing could be obtained with oil-burning engines, it was pointed out that far greater care must be given to the mechanical operation of firing. Unless the fireman follows the operation of the throttle, which affects the draft, very closely, a large amount of smoke will result. It is also necessary that the locomotives be maintained in first-class condition and have a proper distribution of air into the firebox. Leaking steam pipes, leaking flue sheets, improper construction of the firebox, insufficient air supply, improper atomization of the oil, all contribute toward making smoke on oil-burning engines. The brick work in the firebox, especially the brick arch, must be so constructed that there will not be an excessive localization of the heat, which in some cases has resulted in burning off the seams and buttonhead rivets.

The heavy oils should be thoroughly preheated, both in the tank and before they pass out of the burner, to insure prefect atomization. Where steam from the turret is used to atomize the oil it is necessary to have perfectly dry steam, as otherwise the flame is liable to be extinguished, causing explosions, which sometimes blow down the arch. The arch and brick work should be far enough away from the burner to insure the complete combustion of the oil before it strikes the surfaces of the brick work. Oil-burning engines must be fired properly. This will require plenty of competent supervision, as it is very easy for the fireman to become careless in controlling the amount of oil fed to the firebox. The use of the deeper ash pans, which give greater furnace volume, have proved very satisfactory. It is, of course, desirable to keep the firebox at as uniform a temperature as possible, and for this reason when engines come in from the road and are placed in the roundhouse the stacks should be covered in order that the boiler may cool down gradually.

HANDLING OF THE AIR BRAKES

There is no discounting the value of the air brake instruction car, because by it many experiments can be made of the working parts of the system. In connection with the influence train braking and train control have on railroad operation, the road foreman of engines, it is believed, can and should be of the greatest value. As a rule, road foremen of engines, with their assistants, are practical engineers and should be as thoroughly

posted in the air brake, its construction and manipulation as any other part of the machinery and operation in their charge. Possession of a thorough familiarity with the air brake system should permit the road foremen of engines, in their routine work, to explain and demonstrate practically to the enginemen in their charge what is necessary for the best train control. The road foreman undoubtedly has a great opportunity, by reason of his constant road duties, to observe and pick out the men in his territory who will be benefited by special instructions, either as to construction or manipulation.

Smooth train service is very generally dependent on the braking system and its proper manipulation. While good brake manipulation is necessary on the part of the engineer, there is no doubt that the road foreman by the closest observation should be able, through the master mechanics, foremen, repairers and inspectors, to exert the greatest influence toward securing the most favorable conditions possible under the circumstances by co-operation and by pointing out results developing on the road as well as what might be done to improve train operation.

The road foreman of engines, with his thorough knowledge of the road, its grades and train operation, is able to furnish valuable information to the train despatchers, train masters and superintendents with reference to the handling of trains, best meeting points on the division, speed of trains over different portions of the road, the most advantageous location for sidings, switches, signals, water tanks, etc., all influenced to a very great degree by his knowledge of the possibilities in train service and appreciation of train control.

In the engine we have a tremendous reserve power to damage and destroy equipment unless it is carefully handled in starting and stopping, and by careful manipulation of the engine and air brake system good results can be accomplished. Where defective triples and inefficiently braked cars have escaped the inspector, the road foreman of engines may be in the best position, through the co-operation of the engineman, to bring back to the shops and inspection points such object lessons for better service that can in no other way be successfully secured. However careful the shop people may be toward maintaining the equipment, and however diligent those responsible may be in an effort to instruct enginemen in the construction, operation and manipulation of the air brake, the road foreman of engines occupies the position offering the greatest opportunity to lend the most valuable assistance for the best work in the handling of trains, which will result directly in higher efficiency in train service, maintenance of equipment, besides affording more comfortable passenger train service to the traveling public.

The road foreman of engines should direct his interest not only in the handling of engine crews and movement of trains on the road, but should study the construction of the locomotive, its operation, along with the economical use of fuel and supplies, so as to bring back to the mechanical department, being their only representative on the road, any subjects and mechanical matters developing in operation that seem to be open to further improvement.

The road foreman of engines can be of the greatest assistance to the mechanical department and shop people by instructing the enginemen on the road how to make the proper inspection of their engine, and what information should be looked for and the character of reports of most value. In conclusion, we recommend that the road foreman of engines regard the instruction car or exhibitions as a part of his "work shop," and take every opportunity to completely master the subjects that are therein offered for study in such a way as to be better able to explain the system and its operation to the men on the road, illustrating to them what is possible and how it can be best accomplished.

The report is signed by C. M. Kidd, chairman (N. & W.); T. F. Lyons (N. Y. C., West); Geo. Kleifgas, J. B. Hurley (Wab.), and C. P. Cass, (W. A. B.).

DISCUSSION

In order that the road foremen may properly instruct the enginemen in the handling of the air brakes they should see that the repair forces keep the brakes in proper condition. It was believed that it was the duty of the road foremen to instruct in the practical side of operating the brakes rather than to attempt to go into the mechanical details, leaving that to the air brake instructor. A large amount of patience must be exerted by the man instructing the enginemen in the use of air brakes. It has been found to be rather difficult to establish any hard and fast rules for the operation of trains, there being many circumstances arising that will not exactly make the hard and fixed rule practical. Where men have difficulty in handling their trains on certain sections of the road they can be referred to other engineers who operate over the same division and in the same class of service, and who do not experience any trouble. All the mechanical men should bring their influence to bear on the yardmasters, in order to have the trains properly made up. The light, empty cars should be distributed throughout the train among the loads, as otherwise, if they are bunched at the rear break-in-twos are liable to result, and if they are bunched in the head end of the train buckling will be caused. On the Erie a difference in pressure in the train line between the front and rear ends is not permitted to exceed 10 lb. Several roads follow the practice of publishing damage reports showing the causes of the accidents and the damage done, with suggestions, if possible, as to how these accidents may be avoided. These cases are investigated for the good of the service. It was believed to be the best practice to place pusher engines on long trains between the caboose and the train.

SUBJECTS

The following subjects were recommended for consideration at the next convention:

What effect does the mechanical placing of fuel in fireboxes and the lubricating of locomotives have on the cost of operation?

The advantages of the use of superheaters, brick arches and other modern appliances on large locomotives, especially those of the Mallet type.

Smoke prevention.

Make up of freight trains for tangents and grades with reference to draft rigging and lading.

Assignment of power to obtain the most efficient service.

CLOSING EXERCISES

Favorable action was taken on the recommendation that arrangements be made with the International Railway Fuel Association for the holding of the conventions of the two associations consecutively for the purpose of permitting those who are members of both associations to attend the conventions with a reduction in the amount of time these members are absent from their roads. The matter was left to the executive committees of both associations for final adjustment.

Warren S. Stone, grand chief, Brotherhood of Locomotive Engineers, was elected an honorary member of the association.

The attendance was 404 members; the secretary reported a membership of 1,061, and the treasurer reported a cash balance of $7,500. The following officers were elected for the ensuing year: J. R. Scott, president, St. L. & S. F.; B. J. Feeny, first vice-president, Illinois Central; H. F. Henson, second vice-president, N. & W.; W. L. Robinson, third vice-president, B. & O.; G. A. Kell, fourth vice-president, Grand Trunk; A. G. Kinyon, fifth vice-president, S. A. L.; David Meadows, treasurer, M. C., and W. O. Thompson, secretary, N. Y. C.

Chicago received the highest number of votes as the place for holding the next convention.

Covering Steam Pipe Flanges.—In covering steam piping it is often the practice to omit the covering from the flanges and sometimes from the valves and fittings. While the heat thereby lost may or may not represent an item equal to the cost of the covering and labor, the expansion and contraction effect will eventually result in damage to the piping.—*Power.*

NEW YORK CENTRAL SMOKE-WASHING PLANT*

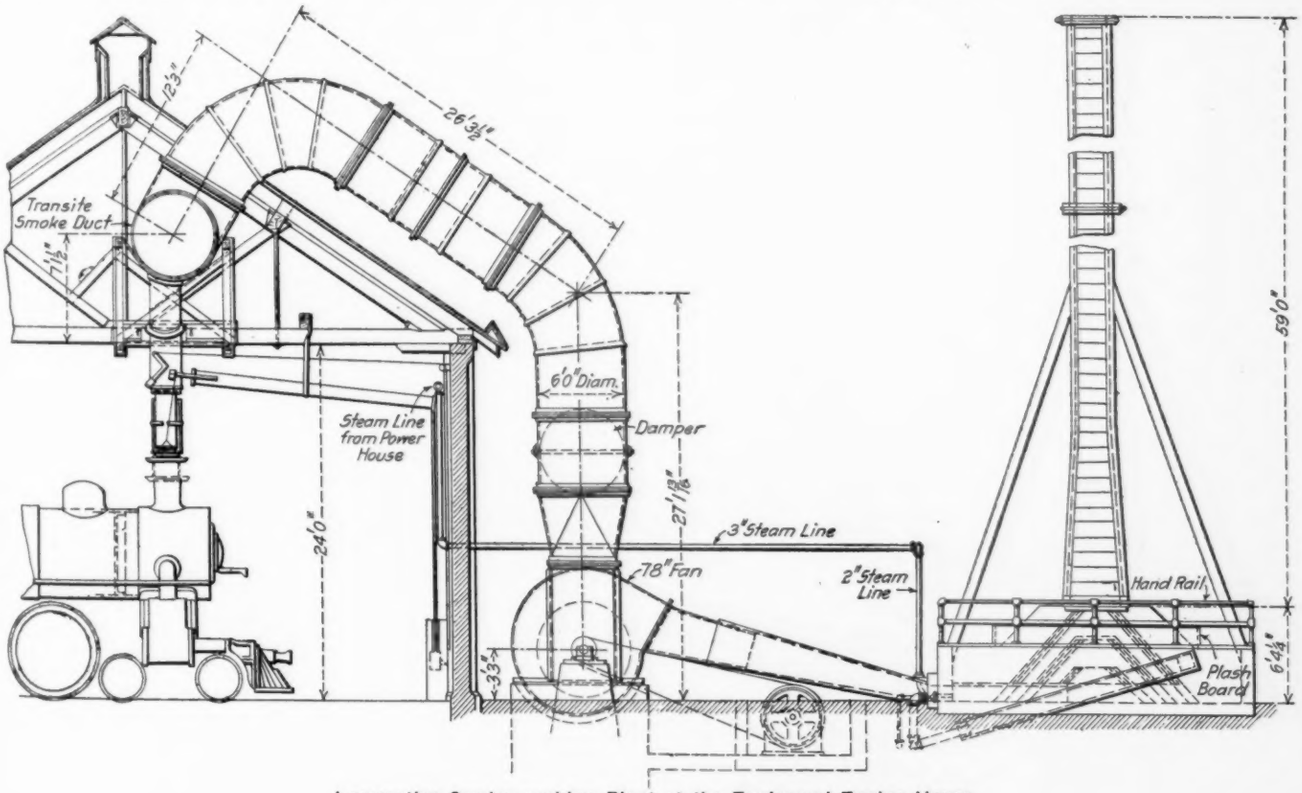
BY M. D. FRANEY
Master Mechanic, New York Central, Elkhart, Ind.

The New York Central engine house in Chicago is located at Englewood station, near Indiana avenue and 63d street. It is adjacent to the White City, a popular amusement park, and surrounded by a very desirable residential district. The citizens are very insistent on the abatement of smoke, and object to the excessive use of the blower which is sometimes necessary for this purpose. While the New York Central locomotives west of Buffalo are equipped with the steam jet smoke consumer, which induces a flow of air above the fire and under the brick arch, and large blower capacity consisting of two 1¼-in. blowers, one on the right and one on the left side, it is found that these appliances are of little assistance in the elimination of smoke when building a new fire in a cold locomotive. This was the great problem which confronted the mechanical officers of the New York Central in 1910, when it was found necessary to build a new engine house and terminal facilities at the Englewood station.

O. M. Foster, master mechanic in this territory at that time, after a careful study of smoke-washing devices, which had been tried at other places with partial success, conceived the idea of forcing the smoke through a large body of water by means of a fan, separating the unconsumed carbon from the gas, permitting the latter to escape through a high stack and holding the carbon and other solids in suspension in the water. D. R. MacBain, superintendent of motive power, who had made a lifelong study of smoke-abatement devices, approved of the plan. A small plant was built at Elkhart, Ind., capable of taking care of one locomotive, which gave results beyond expectation. To more thoroughly test the device, an experimental plant was built at Collinwood, Ohio, to take care of several locomotives. With the data collected from this experimental plant, the present smoke washer at Englewood was designed and constructed. The only drawback was in securing material that would withstand the powerful action of the various acids resulting from the combination of the gases, the solids and water.

The Englewood engine house has 30 stalls, in which from 80 to 100 locomotives are handled every 24 hours. It is built without a single smoke jack leading direct to the atmosphere. In washing the smoke, a large concrete tank is used, 22 ft. by 32 ft. This is subdivided by separating walls into three basins, each of which is lined on the interior with dressed lumber set in about 1½ in. from the concrete. The space between the concrete and the lining is filled with tar. Wooden pins, instead of nails, are used for fastening the lining, in order to resist the action of the acids. The drawings show the plan and elevation of the tank, the stack, the three hoods, the three ducts connecting the fan with the concrete basin, the fan and motor and the elbow connecting the fan with the large smoke duct in the engine house to which the smoke jacks connect.

A large smoke duct, 60 in. in diameter at the center and tapering to 36 in. at the ends, extends around the engine house just under the roof and directly above the smoke stacks of the locomotives when the latter are headed in and standing in normal position. This smoke duct was built of transite material, and is connected with drop pipes leading down to each pit. In each of these drop pipes is a damper which is closed when the jack is not in use. Leading from each drop pipe is a telescopic jack made of cast iron and supported from the roof. These telescopic jacks have vertical, lateral and longitudinal movement to accommodate different positions of the locomotive stack. They are raised and lowered by a walking beam, counterbalanced with a weight and operated from the wall of the engine house. The damper is opened and closed from this same point.



Locomotive Smoke-washing Plant at the Englewood Engine House

Near the center of the house a large elbow connects into the top of the 60-in. transite duct and leads down to a 78-in. steel plate, double-inlet fan, capable of handling 68,000 cu. ft. of gases per minute at 500 deg. at a total static pressure of 14 in. at the fan outlet, and at a speed of 950 r.p.m. The fan is belt-driven by a 300 hp. constant speed, 300-400 r.p.m. motor. A smoke duct

* From a paper presented at the tenth annual convention of the International Association for the Prevention of Smoke.

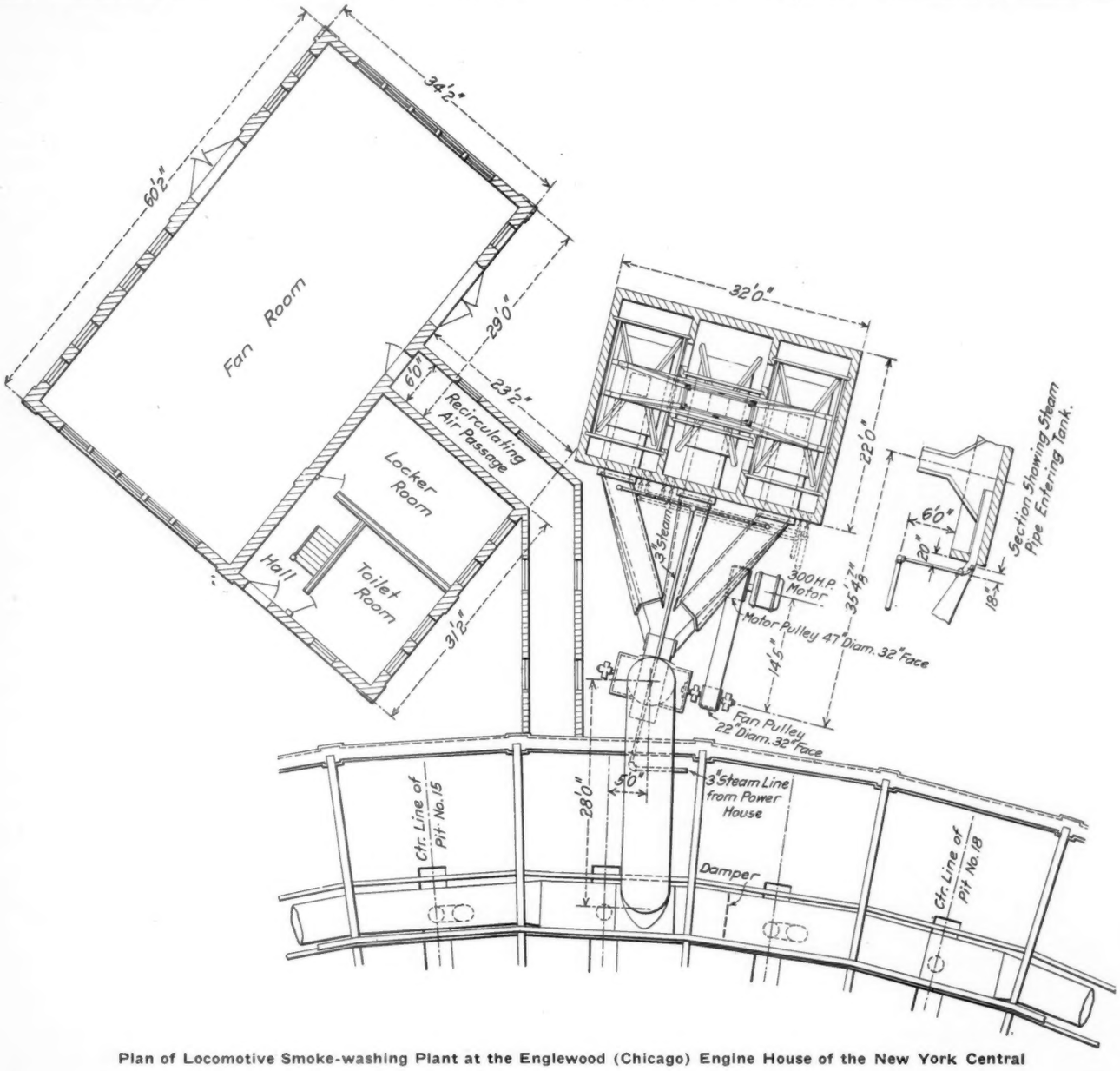
leads from the fan to each of the three concrete basins, the outlet to each duct coming directly under the hoods referred to above. There are three hoods in each tank. The top of the interior hood is open, while the top of the second hood is closed similar to a bell; the top of the third or outer hood is open and connects with the stack, which is approximately 60 ft. high. The three smoke ducts leading from the fan, the hoods and the stack are made of wood pinned together with pegs instead of nails. The lower portions of the three hoods extend down in the concrete basin and are submerged in the water.

An 8-in. hole is provided in each of the separating walls to insure a uniform level of water in the three basins. A special overflow pipe is provided to maintain 14 in. of water in the tanks and to prevent the carbon from escaping into the sewer. A 1¼-in. high-pressure steam jet, with proper elbow and nozzle pointing toward the outlet, is located in each of the three ducts and close to the concrete tank. The purpose of these steam jets is to accelerate and thoroughly mix the gases with the water and prevent them passing through the water in large bubbles. The gases are forced from the fan through the three smoke ducts into the water, passing out into the first hood. The water being thoroughly agitated at this point by the steam jets referred to, the gases are engulfed by the spray and wave action of the water and pass out through the top of the first hood into the second hood or bell, which, it will be remembered, has a closed top. They are forced down below the lower edge of this hood and pass to the third hood, and out of the water into the stack.

The carbons and solids are separated from the gases as they are forced through the water and rise to the top of the water in the tank in the form of a black, foamy scum. The gases pass out through the stack as a white vapor, practically odorless. In handling 80 locomotives in 24 hours, from 8 to 10 barrels of carbon are obtained from the smoke washer. This has the appearance of lampblack, and is thoroughly steam-dried after it is taken from the smoke washer. An analysis of this material is as follows:

Moisture	3.9 per cent
Carbon	82.6 per cent
Sulphur	2.6 per cent
Iron oxide	8.7 per cent
Silica	1.8 per cent
Calcium oxide	trace

The sulphur and sulphuric acids are retained in the water. The city smoke department of Chicago and the nearby residents are well pleased with the results obtained and on numerous occasions have complimented the plant very highly.



Plan of Locomotive Smoke-washing Plant at the Englewood (Chicago) Engine House of the New York Central

The estimated cost of making such an installation is from $15,000 to $18,000, where the property conditions are favorable. Owing to the property conditions and to the fact that the Englewood plant is an experimental one, the actual cost was somewhat greater. We made an investigation some time ago as to the cost of operation:

COST OF OPERATION PER DAY OF 24 HOURS

Water, 18,255 gallons, @ 7 cents per M	$1.28
Coal, 10.86 tons, @ $1.75 per ton	19.00
Electricity, 3,360 kilowatt hrs., @ $0.0129	43.34
Total	$63.62

SAVING EFFECTED BY THE USE OF WASHER PER DAY OF 24 HOURS.

Fires maintained	$40.80
New fires built	7.11
Reduced electrical cost due to sliding scale rate	8.52
Total	$56.43

This makes the net cost of operating the washer $7.19 per day of 24 hours ($63.62 less $56.43). It is expected that we will be able to find a profitable use for the lampblack reclaimed by the smoke washer. This would, of course, result in still further decreasing the net cost of operation and might possibly show a profit.

We have found that where the fires are properly started the draft from the fan is sufficient to draw off the gases from the locomotive without the use of the blower. This means a decided reduction in the amount of water used, due to not using the steam blower, and also means a decided saving in coal consumption, due to the reduced draft. While we have quoted the results of some tests, it is difficult to obtain a set figure as to the amount of coal and water consumed by an engine at a terminal, due to varying conditions, such as smoke restrictions, temperature of the weather, and the human element or fire-up men. However, the tests showed to our entire satisfaction that the coal and water consumption is materially reduced on engines stored under the smoke jack and influenced by the draft of the smoke washer fan. The temperature of the firebox is more even and the fire-up man is able to handle a larger number of locomotives.

This smoke washer is operated under patents controlled by the American Smoke Washing Company, incorporated in Illinois, of which S. K. Dickerson, 5120 Greenwood avenue, Chicago, is secretary.

PREPARED PAINTS FOR METAL SURFACES*

BY HENRY H. GARDNER
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In designing protective coatings for metal the modern practice has been to apply the results available from researches into the cause of corrosion. These results have shown that materials of a basic nature, or substances which contain soluble chromates, prevent the rusting of iron. For this reason pigments of a basic nature or pigments containing the chromate radical have come into wide use in the manufacture of protective paints. That they are the best pigments for this purpose has been proved not only in practice, but also in the Atlantic City tests,† which were made on a series of 300 large steel panels, using nearly 100 different pigment paints. Applying the results of these tests to the practical manufacture of protective coatings, the writer will discuss the use of the various pigments under separate headings, taking up the composition of the most widely used colors for metal painting, namely, red, gray, black and green. Most of the paints outlined herewith are suitable for the painting of structural steel, bridges, steel railroad cars and equipment, ornamental ironwork, poles, posts and for general work on metal surfaces.

Red Lead Priming Paints.—It is well understood that one of the most valuable properties of red lead is its ability to set up to a hard, elastic film that shuts out moisture and gases which are apt to cause corrosion. This cementing action is due to the presence of unburnt litharge, a pigment which rapidly reacts upon linseed oil to form a lead linoleate compound. It will readily be seen, therefore, that red lead free from litharge has no cementing action and should not be considered more protective than iron oxide or any other similar neutral pigment. It is thoroughly essential that red lead should be highly basic and should contain a considerable percentage of litharge, if it is to protect iron from corrosion. It is a growing custom to use prepared red-lead paints made from finely divided red lead ground to a fluid condition in linseed oil. Such paints remain in excellent condition for a long period of time. They have a high protective value and are well suited for general purposes. They are used extensively for priming steel vessels. The Navy Department has found that inert pigments, such as silica and asbestine, give good results when used in ready mixed red-lead paints, their action being to prevent settling of the red lead upon storage.

A specification which may be used by the grinder when purchasing dry red lead prepared paints is given herewith:

1. The dry pigment to be the best quality, free from all adulterants, and to contain not less than 85 per cent nor more than 90 per cent Pb_3O_4, the remainder being practically pure lead monoxide (PbO).
2. It shall contain not more than 0.1 per cent of metallic lead, nor more than 0.1 per cent of alkali figured as Na_2O.
3. It shall be of such fineness that not more than 0.5 per cent remains after washing with water through a No. 21 silk bolting-cloth sieve.

NOTE.—If desired, the gram weight of the red lead may be specified. Extremely light, fluffy red lead should run from 10 to 13 grams per cubic inch. Medium red lead will run from 13 to 16 grams per cubic inch. Heavy red lead will run from 17 to 19 grams per cubic inch.

Composition of Red-Lead Priming Paints.—The cost of red-lead paints is a subject of vital importance to the large user. Red lead may be produced in different physical states. Ordinarily the grade that has been overburned is extremely heavy, 1 cu. in. weighing from 18 to 20 grams. For the production of a paint from such red lead, according to the formula used by one large consumer, the following quantities would be required:

Red lead	26 lbs.
Linseed oil	26 gills
Petroleum spirits	3 gills
Drier	3 gills

This would produce approximately 1 2/5 gal. of paint. Each gallon would contain about 20 lb. of red lead, the actual cost of the red lead itself being in the neighborhood of $1.60. A red lead of a much better protective value, containing from 10 to 12 per cent of free litharge and produced in an extremely fine physical state of comminution, so that 1 cu. in. would not weigh over 12 to 15 grams, would produce a paint of exactly the same body on the following formula:

Red lead	20 lbs.
Raw linseed oil	26 gills
Turpentine	3 gills
Drier	3 gills

This would produce approximately 1⅓ gals. of paint, each gallon of which would contain about 15 lb. of red lead, the actual cost of the dry pigment per gallon being in the neighborhood of $1.20. Red lead of still lighter gram weight could be used, so that a still smaller quantity of pigment would be required per gallon of oil. The durability of such paints should compare favorably with those containing very high percentages of red lead of high gram weight. Pigments of an extremely light nature, such as lampblack, grind in very large quantities of oil, yet their films are more elastic and durable than many paints which are composed of much pigment and little oil.

Red Paints.—Iron oxide has always been one of the most widely used pigments for the manufacture of protective coatings. Oxides that are free from acid or soluble substances give the best results. There are many grades, from the bril-

*Presented at the Forty-sixth Annual Convention of the Master Car and Locomotive Painters' Association.

†For full description of tests and further information see Proc. Amer. Soc. for Test. Mater., Vol. IX, 1909, pp. 203 and 204; Vol. X, 1910, pp. 79-86; Vol. XI, 1911, pp. 192-194; Vol. XIII, 1913, pp. 369-371; Vol. XIV, 1914, pp. 259 and 260.

liant Indian reds, containing 98 per cent, down to the natural mined brown shale oxides, containing from 30 to 60 per cent of ferric oxide, the balance being silica, clay, etc. Venetian reds, consisting of about equal parts of ferric oxide and calcium sulphate, are also quite widely used. It is customary to add to iron oxides from 10 to 20 per cent of zinc chromate, zinc oxide, or red lead, in order to make them rust inhibitive. Such red paints are widely used for application to tin roofs, metal siding and general structural steel. Red paints made from basic lead chromate (American vermilion), the pigment which gave the best results in the Atlantic City tests, would doubtless be the most economical in the long run, but the high cost will probably prevent their use to any great extent. The use of a percentage of basic chromate of lead in iron-oxide paints is to be approved.

Gray Paints.—Mixtures of white lead (basic carbonate or basic sulphate) and zinc oxide, tinted gray with carbon black, are widely used and give excellent results in every climate.

A valuable rust-inhibitive coating for general priming or finishing work may be prepared from sublimed blue lead. The use of two parts of blue lead and one part of linseed oil containing about 5 per cent of turpentine drier makes a paint of the right consistency. This may be purchased in prepared form. The rust-inhibitive value of this pigment is due to the high percentage of lead oxide (litharge). When purchased ground to a paste in 10 parts of oil, there should be added approximately 5 gals. of linseed oil and 1 pt. of drier for use. A specification for blue lead for use in metallic paints is given herewith:

	Minimum	Maximum
Lead sulphate	44 per cent	52 per cent
Lead oxide	33 per cent	40 per cent
Lead sulphide		0.5 per cent
Lead sulphite		3.5 per cent
Zinc oxide		3.0 per cent

Black Paints.—Black paints are often preferred for the finishing coat on steelwork, carbonaceous paints being unsuited for application direct to the metal on account of their rust-stimulative action. Carbon pigments, such as gas carbon black, oil black, artificial and natural graphite (flake and amorphous) are usually the base pigments used in black paints. Silica and other earth pigments may be combined with the carbon. The slow-drying nature of such paints is lessened by the addition of litharge. The use of boiled linseed oil as a vehicle is advisable.

Magnetic black oxide of iron (precipitated) forms an excellent black protective paint when ground in linseed oil. The slightly basic character of this pigment accounts for its inhibitive value. The natural variety of black magnetic oxide of iron is also suitable for this purpose, but should be tested for freedom from soluble acid impurities before use. Willow charcoal is not made in commercial quantity; its use, therefore, will be restricted. Its inhibitive value depends on the basic nature of the impurities present.

Green Paints.—Mixtures of zinc chromate and Prussian blue in oil are highly inhibitive and have proved satisfactory in long service tests. Chrome yellow tinted with black oxide of iron to an olive shade is permanent and protective. Chrome green made from lead chromate and Prussian blue is generally used when precipitated upon a barytes base.

Painting Galvanized Iron.—Roofing, siding, railing, drain pipes, cornice work, etc., constructed of galvanized iron require painting if they are to be kept in a good state of preservation. Paints are apt to peel from galvanized iron on account of the smooth, spangled surface. This condition, however, is obviated by first treating the metal before painting with a solution of copper salts. Such a solution may be prepared by dissolving 4 oz. of copper acetate, copper chloride or copper sulphate in one gallon of water. By brushing on this solution the galvanized iron is roughened, a thin deposit of copper being plated out over the surface. After an hour or so, the surface may be lightly brushed and then painted with a thoroughly inhibitive oil paint. Firmly adhering films are thus produced.

Painting Tinned Surfaces.—Tin plate, such as is used for roofing and siding, will rapidly corrode unless protected by paint. The pin-holes present in the tin coating on the steel base metal act as pockets to catch moisture, which causes rust spots and pit-holes. Before applying paint to the sheets it is advisable to rub the surface of the tin with a cotton rag saturated with benzine or turpentine. This will remove the palm oil that is present on the surface and allow the paint to firmly adhere. Iron-oxide paints containing an inhibitive pigment are widely used for preserving tin. The use of 15 to 20 per cent of zinc oxide, red lead or zinc chromate with a neutral bright iron oxide produces an excellent paint. The partial use of boiled linseed oil or kauri gum mixing varnish will add to the gloss and water resistance. Such paints are also suited for use on metal shingles and pressed-steel siding—plain black, galvanized or tinned. For dipping purposes, turpentine or high boiling point mineral spirits should be used for thinning. Cheap driers containing a low boiling point benzine should be avoided.

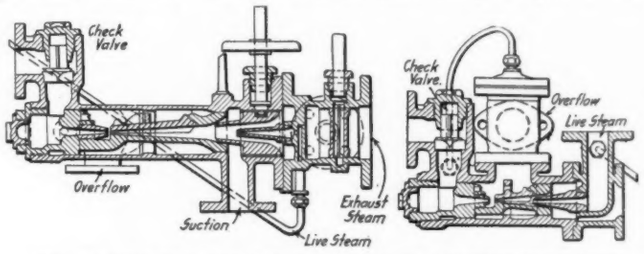
EXHAUST INJECTORS

BY ROBERT W. ROGERS
Instructor of Apprentices, Erie Railroad, Port Jervis, N. Y.

Exhaust steam from the cylinders has been used for some time in British practice for injecting the feed water into the boiler, either alone or in combining with live steam. Injectors of the combination type are sometimes made in two sections, and sometimes the two parts are combined in one body. The drawing shows the two parts of the former type separated, that at the right being the exhaust steam section and that at the left the live steam section.

The exhaust steam section takes the feed water from the tender at atmospheric temperature and raises it nearly to the boiling point. In addition to the heating effect a pressure of 70 lb. per sq. in. is exerted on the water, and it is delivered at this pressure and temperature to the live steam section, which forces it into the boiler. With injectors of this type the temperature of the water delivered to the boiler reaches 270 deg. F.

Automatic action is attained in this type of injector by the construction of the combining tube. This tube is divided longitudinally into two parts, the upper part being hinged to the lower. When in operation the tube acts as a unit in the usual way, but when the jet breaks the two halves of the tube are forced apart, thus affording a temporary free outlet which is required to re-establish the normal action of the injector. A small pipe extends from the live steam section to the exhaust section through which live steam is supplied in small quantities to the exhaust section in order that it may be operated when the locomotive is standing or drifting. In starting the self-acting injector the steam and water supply valves are opened and the water supply is regulated by a valve in the suction pipe until the overflow ceases.



The Exhaust and Live Steam Sections of a Combination Type Injector

In the development of the exhaust injector it has been found that, owing to the presence of oil in the exhaust steam, the feed pipes rapidly become choked up; a grease cap or separator is therefore generally provided in the exhaust steam line, which removes the oil from the steam before it enters the injector.

CAR DEPARTMENT

DESIGN OF STEEL PASSENGER EQUIPMENT

BY VICTOR W. ZILEN
Associate, American Society of Mechanical Engineers

II

SPRINGS

Considerable information is available on the design of springs and the laws governing strength and flexibility are well known. The effect on physical properties, however, of heat treatment and other variables leads to some speculation on the part of designers as to just what should be the proper allowance for fiber stress in order to obtain the most economical sections. It is common practice to allow 80,000 lb. per sq. in. under maximum static load. No doubt this could be exceeded if scientific treatment in manufacture is carried out with precision.

The method so long used of shaping springs by hand, quenching them in oil and afterwards toughening them by slow heating and gradual softening, the high temperatures being determined by color as seen by the spring maker's eye, is extremely uncertain. The results obtained are not fully satisfactory, because much depends upon the susceptibility of the retina to light as well as upon the degree of illumination under which the observation is made. New methods are gradually coming into general use in which the furnace temperatures are maintained under close regulation and accurately measured, but some unreliability probably still exists, and unless the various appliances are checked up from time to time and kept in order they may possess no advantage over the older method. However, the car designer is interested in the results obtained from the spring rather than the method of its manufacture, and since few roads have modern appliances for the repair of springs, the writer feels that 80,000 lb. per sq. in. may still be considered the maximum safe unit stress under static load.

Many formulas are found for the calculation of elliptic and semi-elliptic springs, all of which are based on the same fundamental principles. The formula of Realeaux is quite generally used. For semi-elliptic springs this formula is

$$P = \frac{S\,n\,b\,h^2}{6L} \qquad (21)$$

$$D = \frac{S\,L^2}{E\,h} \qquad (22)$$

in which
P = static load on one end.
L = ¼ span in inches less ¼ width of band.
S = stress lb. per sq. in.
b = width of plates, in.
n = number of plates.
E = modulus of elasticity = 29,400,000.
h = thickness of plate (should be about .02L).
D = deflection.

For full elliptic springs D has twice the value given above. The formula assumes that the edge of the band is ineffective. The ratio of full-length plates to the whole number required is ¼; the last full-length plate should be tapered at the ends and the remaining plates regularly shortened and tapered. The length of the shortest plate should not be less than twice the length of the spring band.

In car work the dimensions of springs are limited by available space, and a length of about 40 in. between centers is seldom exceeded. For ideal operation the point of suspension should be chosen so that the ratio of the static to the dynamic loads will be the same as the predetermined ratio of the allowable static and dynamic fiber stresses, but for practical reasons a point in line with the journal bearings is preferable. Space between bands must be such that when springs are solid the stress may be well within the elastic limit.

In the discussion of axles, it will be remembered that the value of H was found by formula (11) to be 17,277 lb. This is the centrifugal force, due to the weight on one axle, acting at its center of gravity and for a given speed varies directly as the weight producing it. For any portion of the car the value of H acting at its center of gravity may be found by simple proportion. In Fig. 2 let

H_1 = the horizontal force required at the center of gravity of the weight above the springs.
H = 17,277 lb.
W_1 = 52,000 lb. = weight on springs including weight of passengers.
W = weight on one axle = 31,000 lb.

The value of H_1 will then be found as follows:

$$H_1 = \frac{W_1 H}{W} = \frac{52,000}{31,000} \times 17,277 = 29,000.$$

Taking moments about C, the intersection of the vertical and horizontal center lines of one of the springs, we have for equilibrium of the car above the springs:

$$P_2\,l + H_1\,a_1 = \frac{W\,l}{2}$$

$$P_1 + P_2 = W_1.$$

From this the loads on the springs are found to be

$$P_2 = \frac{W_1}{2} - \frac{H_1\,a_1}{l} \qquad (23)$$

$$P_1 = \frac{W_1}{2} + \frac{H_1\,a_1}{l} \qquad (24)$$

The latter becomes

$$P_1 = \frac{52,000}{2} + \frac{29,000 \times 46}{76} = 43,600 \text{ lb.}$$

when the following values are substituted:

a = 70 in.
a_2 = 24 in.
$a_1 = a - a_2 = 70 - 24 = 46$ in.
l = 76 in.

From this it is seen that the load per group of springs due to combined vertical and horizontal forces may be found by (24) and the space between bands may be proportioned accordingly.

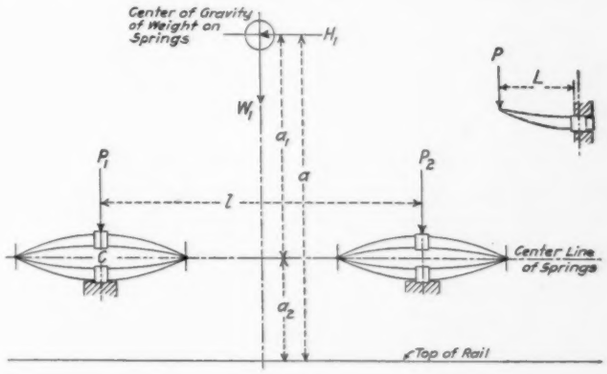


Fig. 2

For the given values P_1 was found by formula (24) to be 43,600 lb., while the static load per group of springs is 26,000 lb. From formula (21) we know that stress S varies directly as the load P. Then let

P_2 = 26,000 lb. maximum static load per group of springs on one side of the truck.
P_1 = 43,600 lb. maximum load due to vertical and horizontal loading combined.
S_s = fiber stress for static load.
S_c = fiber stress when springs are solid = 120,000 lb.

Then solving for the fiber stress under static load

$$\frac{S_s}{S_c} = \frac{P_2}{P_1} \text{ or } S_s = \frac{P_2 S_c}{P_1} \qquad (25)$$

$$S_s = \frac{26,000 \times 120,000}{43,600} = 71,600 \text{ lb. per sq. in.}$$

If we wish to make S_s = 80,000 lb., S_c would be 134,000 lb., which probably is too high for safety, and unless the value of

P_1, as affected by the position of the springs, can be reduced, the values of 71,600 and 120,000 for S_s and S_c should be used.

HELICAL SPRINGS

What has been said in regard to manufacture, arrangement, position and dimensions of elliptic springs is equally true in the case of helical springs. In case of a four-wheel truck, the springs should be as close to the journal box as possible, the top of the box being the most preferable location, for the reason that it is the point of reaction for all the loads. A lighter spring may therefore be used at this point than at any other location.

It is considered good practice not to have the diameter of the rod from which the spring is to be made more than one-quarter the outside diameter of the spring, and when placing one spring on the inside of the other they should be coiled right and left. The maximum fiber stress allowable is between 80,000 lb. and 90,000 lb. when the spring is compressed solid. This should occur only when the maximum condition of loading is reached. This condition may be determined by the same procedure followed in deriving formulas (24) and (25) for elliptical springs. Referring to Fig. 2,

$$H_1 = \frac{W_1 H}{W}$$

in which

W_1 = say 30,500 lb. = weight on springs including weight of passengers.
H = 17,277 lb.
W = weight on axle = 31,000 lb.

In this case W_1 is one-half the weight above the coil springs on one truck, since there are four sets of coil springs. Substituting these values

$$H_1 = \frac{30{,}500 \times 17{,}277}{31{,}000} = 17{,}000 \text{ lb.}$$

and if the following values for the dimensions shown in Fig. 2 are used

a = 66 in. from top of rail to the center of gravity of the weight on helical springs.
a_2 = 26 in. from rail to center of springs.
a_1 = 40 in
l = 76 in.

the values of P_1 and S_s may be determined by formulas (24) and (25)

$$P_1 = \frac{30{,}100}{2} + \frac{17{,}000 \times 40}{76} = 24{,}000 \text{ lb.}$$

$$S_s = \frac{15{,}050 \times 90{,}000}{24{,}000} = 56{,}400 \text{ lb. per sq. in.}$$

In this case the maximum fiber stress of the springs when solid is 90,000 lb., which limits the fiber stress under the static load to 56,400 lb.

To secure an easy riding truck the total deflection for helical and elliptical springs combined should be as liberal as practical conditions will permit, the limit being the maximum side sway a car may have sidewise at eaves without exceeding the clearance line of tunnels, bridges, etc.

The required dimensions for helical springs will be found by the following formulas:

$$P = \frac{S \pi d^3}{16 r}, \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (26)$$

$$f = \frac{4 S r^2 \pi h}{G d^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (27)$$

in which

G = 12,600,000.
P = load at solid height in lb.
S = stress in lb. per sq. in.
d = dia. of steel in in.
r = radius of center of coil in in.
h = solid height of spring in in.
f = deflection in in.

In obtaining the deflection for one inch of solid height $h = 1$, and may be omitted in (27). Formulas (26) and (27) may be simplified by letting $\frac{\pi S}{16} = c$ and $\frac{4 \pi S}{G} = k$. Substituting c in (26) and k in (27)

$$P = c \frac{d^3}{r} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (28)$$

$$f = k \frac{r^2 h}{d^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (29)$$

S = 80,000, c = 15,708, k = .08
S = 85,000, c = 16,700, k = .0847
S = 90,000, c = 17,672, k = .08976
S = 95,000, c = 18,650, k = .09474

The following table gives values of the constants c and k for values of unit stress from 80,000 lb. to 95,000 lb.:

S	c	k
80,000	15,708	.08000
85,000	16,700	.08470
90,000	17,672	.08976
95,000	18,650	.09474

THE CAR DEPARTMENT AND THE EXPEDITING OF PREFERRED FREIGHT

M. J. O'Connor, special inspector of the New York Central, read a paper on "Ways and Means of Expediting Movement of Cars Loaded with Preferred Freight" at the September meeting of the Niagara Frontier Car Men's Association at Buffalo, from which the following is taken:

The car department is a prime factor in the prompt and safe movement of freight trains, and I will endeavor to describe from a car department point of view what the contributing elements are:

(1) By covering the inspection and necessary light or running repairs to cars at freight houses and industrial plants prior to loading the cars it will avoid marking them to repair track later on, or holding them for necessary repairs after they are received in train yards; as a result trains can be gotten out of terminals with a minimum delay.

(2) The inspection of the air brake apparatus and the adjustment of brakes in the receiving yard, also the marking out of all cars on which the air brakes are not in perfect order, assists materially when making the final air brake test after the road engine is coupled to train in the classification yard. It is a feature of the inspection that should be given special attention, as it is an acknowledged fact that where this is done it has been the means of reducing the number of burst air hose en route, and the consequent damage to equipment, likewise serious delay to trains.

(3) Treating the journal boxes of cars after they are assembled in trains will disclose whether the packing and contained parts are in the best possible condition. Where this practice is followed conscientiously it will reduce the trouble experienced with hot boxes to a minimum. While this is a failure the railroads have always had to contend with, I have no hesitation in stating that by specializing on this work the trouble with hot boxes can be reduced fully 40 per cent.

(4) Co-operation with train crews is most important from the fact that when cars are moving over the line they are beyond the jurisdiction of the car inspector. This co-operation can be established to a better degree and understanding by having inspectors in a special capacity ride the important freight trains, as this not only brings to light any irregularities, but is a means of educating the train crews to the nature of defects on cars; should a slight defect develop while en route they are thus better qualified to know whether the car is safe to move to a terminal, which knowledge will prevent the unnecessary cutting out of cars carrying preferred freight.

Imports From Germany.—Imports from Germany into the United States for May, 1915, were only $3,172,630, compared with $14,661,923 in May, 1914. The largest item was toys at $447,976, the next being earthen, stone and china ware at $225,758.—*Iron Age.*

Higher Lineshaft Speeds.—In many factories, the lineshafts run too slowly and consequently most of the machines provided with cone drives are so speeded that the slowest speeds obtainable on the machine are seldom or never used. A Connecticut manufacturer of machine products has set a good example by speeding his lineshafts so that the slowest speeds that can be obtained on any machine are the slowest that ever will be required. The general effect has been to use higher speeds on all work from the lowest turning speed to the highest filing speed.—*Machinery.*

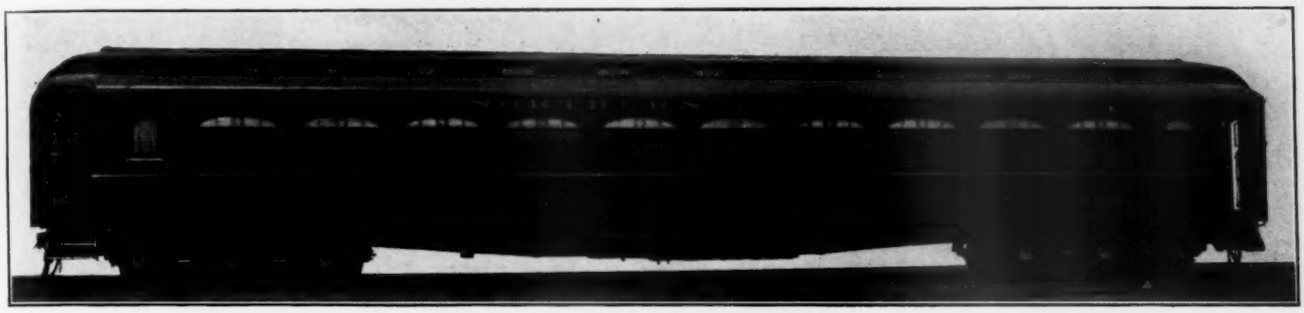
NORTHERN PACIFIC PASSENGER CARS

Example of Standard Construction for Various Classes of All-Steel Passenger Train Cars

The Northern Pacific has recently received from the Pullman Company 47 coaches, 22 mail and express cars, 17 baggage cars and 6 dining cars of all-steel construction, 10 of the baggage cars and 4 of the mail and express cars being equipped with the head end generator sets of which two were of the axle machine train

Length over end sills (Dining Cars)	72 ft. 10 in.
Length over end sills (Other Cars)	70 ft. 10 in.
Width over side sills	10 ft. 1⅝ in.
Rail to top of floor	4 ft. 5⅜ in.
Truck wheels, number and diameter	6—36 in.
Journals	5 in. by 9 in.

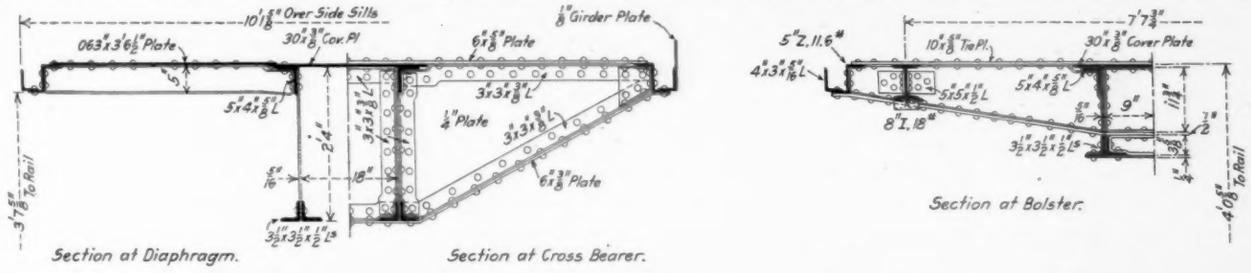
The weight of the coaches is 141,100 lb.; the mail and express

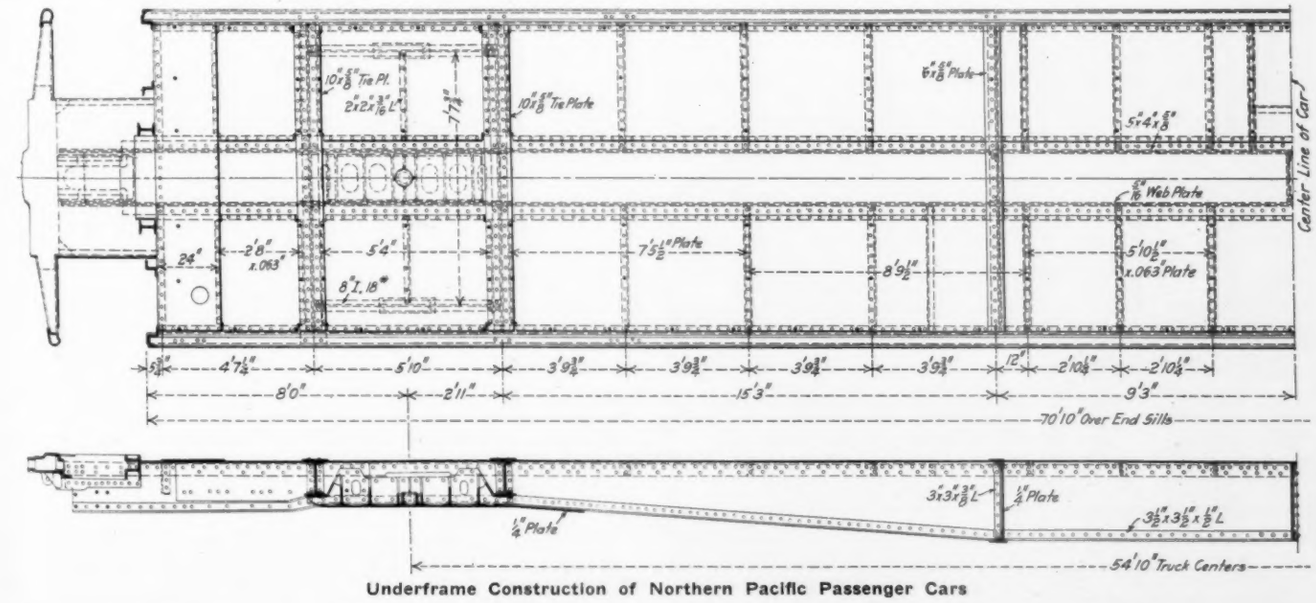


Northern Pacific All-Steel Passenger Coach

lighter type. The interesting feature of these cars is the marked similarity in their construction. The trucks are identical, the underframe practically so, and the framing only different in characteristic details, the coaches and diners being designed to carry

cars, 140,300 lb. without, and 146,200 lb. with the lighting dynamo; the baggage cars, 127,800 lb., without the lighting dynamo, and 139,800 lb. with, and the dining cars, 160,100 lb. The coaches have a seating capacity of 84, and the diners 30. Vestibule ends





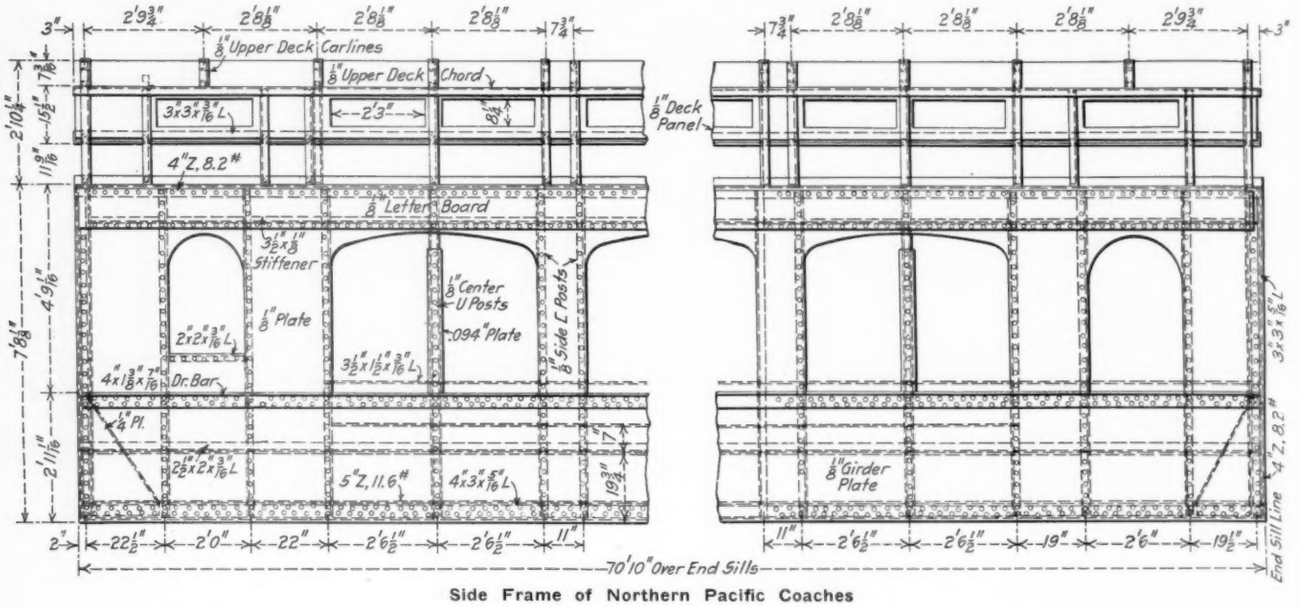
Underframe Construction of Northern Pacific Passenger Cars

a live load of 20,000 lb. and 18,000 lb. respectively, and the other cars 50,000 lb. Many of the Northern Pacific standard parts were used and, where possible, steel castings were used in preference to forgings. The cars all have the same general dimensions, which are as follows:

are used on the coaches and diners, the side doors and steps being wider than usual. The other cars have stub ends.

The coaches have a natural Mexican mahogany finish from the window sills to the lower head lining and 7/16-in. fireproof Agasote below the windows to the baseboard. The ceiling is

of the half empire style, with 3/16-in, fireproof Agasote head lining finished in pearl color with gold stripes. The diners are finished in Cuban mahogany with the exception of the kitchen, which is finished in plain oak. Agasote is used below the window sills and on the ceiling, which is of the full empire style. It



Side Frame of Northern Pacific Coaches

is decorated in pearl color with gold stripes. Pressed prism plate glass embodying the Northern Pacific monad emblem design at the center is used for saloon, deck and gothic windows of the coaches and diners. On the coaches the prism glass was applied both inside and outside at the gothics, while in the dining-room of the diners the space usually taken by the gothics was incorporated in the main window, making the clear glass 36 in. high by 47 in. wide. These large and extra high windows are particularly adapted to afford unobstructed views. The oval aspect of the windows, which is the Northern Pacific standard for wooden cars, has been maintained in these cars. The flooring in

Interior of Northern Pacific Dining Cars

the coaches and the dining rooms of dining cars is of flexolith the color of which is natural gray in the dining cars and tinted red color in the coaches to harmonize with the inside finish.

The baggage and the mail and express cars have an inside sheathing of 13/16-in. by 5⅛-in. poplar, with a ceiling of 3/16-in. Agasote. A 1⅛-in. poplar partition separates the dynamo compartment from the rest of the car. All of the baggage and the mail and express cars not equipped with dynamos were designed so that they may readily be so equipped. The mail and express cars were so constructed that the 30-ft. mail compartment can readily be converted into a 40-ft. compartment, and for that purpose a blind door was built in each side of these cars.

All the cars are equipped with Northern Pacific special buffing devices, which have a capacity of 350,000 lb., and also with three-stem couplers having 8-in. tandem draft gear using one 8-in. plain and one 8-in. friction draft spring at each end of each car. The coaches, dining cars and combination mail and express cars are equipped with automatic deck ventilators with intake and exhaust working in conjunction. Eighteen of these ventilators are provided for each coach and seventeen for each dining car.

UNDERFRAME

The longitudinal sills are designed to resist the maximum shock due to buffing, which is assumed to be the equivalent of a static load of 400,000 lb. applied horizontally at the resultant lines of force acting at the center line of the buffing mechanism and at the center line of the draft gear, respectively. For this stress only the underframe members are considered, the superstructure being considered as supporting the underframe from buckling vertically.

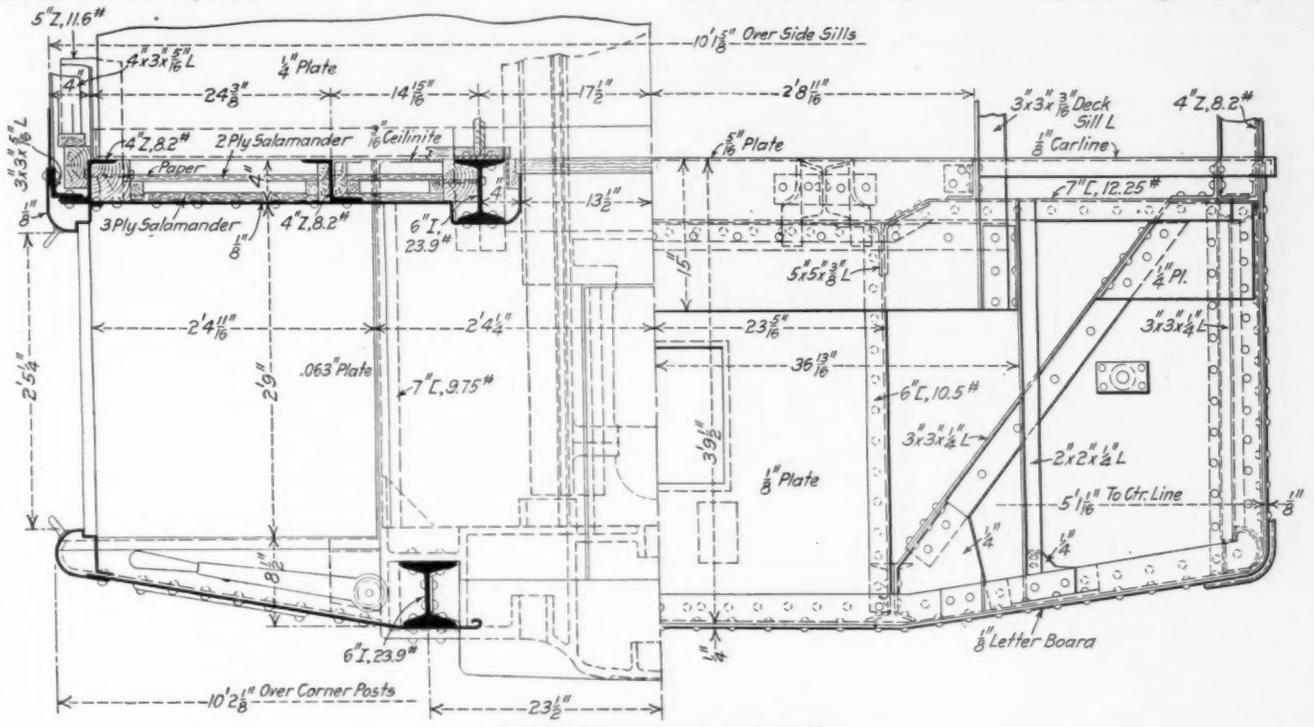
The underframe is made up entirely of plates and structural steel shapes and is, in general, used on all types of cars included in this article. The center sill is of the fish-belly box-girder type with bottom cover plates only at the bolsters and cross-bearers. It is 2 ft. 4 in. deep at the center and 15⅞ in. deep at the ends. The webs are 5/16-in. plates spaced 18 in. apart, being reinforced with 5-in. by 4-in. by ⅝-in. angles on the outside at the top and with 3½-in. by 3½-in. by ½-in. angles on both sides at the bottom.

The top cover plate for the stub-end cars is ½ in. by 30 in. and extends to within 2 ft. 1¾ in. of each end sill, while that for the vestibule cars is ⅜ in. thick and it extends a few inches beyond the end sill. On all of the cars the center sills terminate at the buffing plate. The body bolsters are of the double type, consisting of 5/16-in. pressed steel pans placed back to back, the side members being 5 ft. 10 in. apart. A cast-steel center plate is enclosed in the center sill girder and is designed to receive the Coleman locking device. The side bearings are

carried on 8-in., 18-lb. I-beams located 3 ft. 9⅞ in. each side of the longitudinal center line, and extending between the side members of the body bolsters.

bottom cover plate, ⅜ in. by 6 in., extend in single pieces from side sill to side sill.

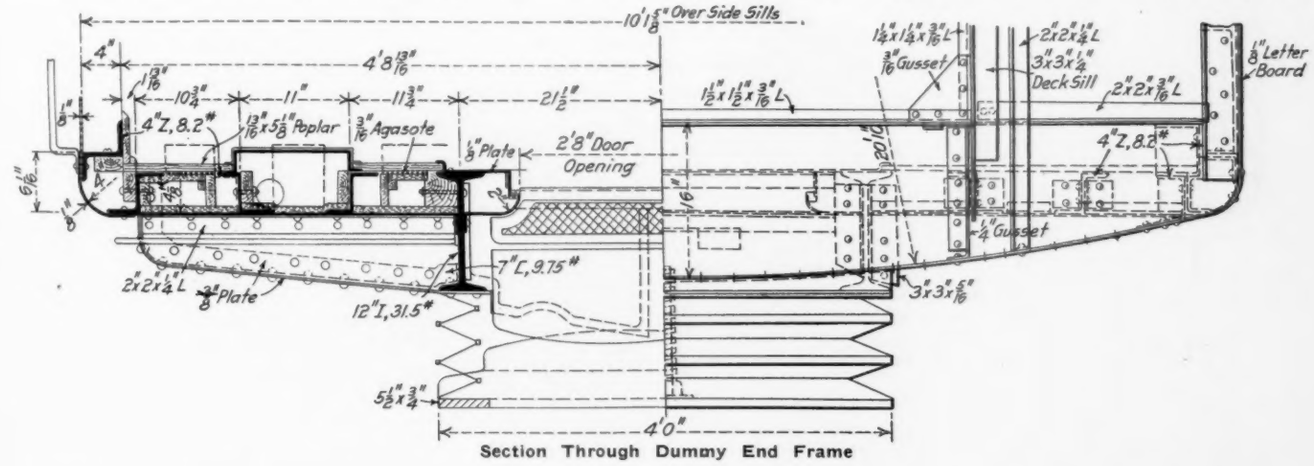
The side sills are 5-in., 11.6-lb. Z-bars, extending in one piece



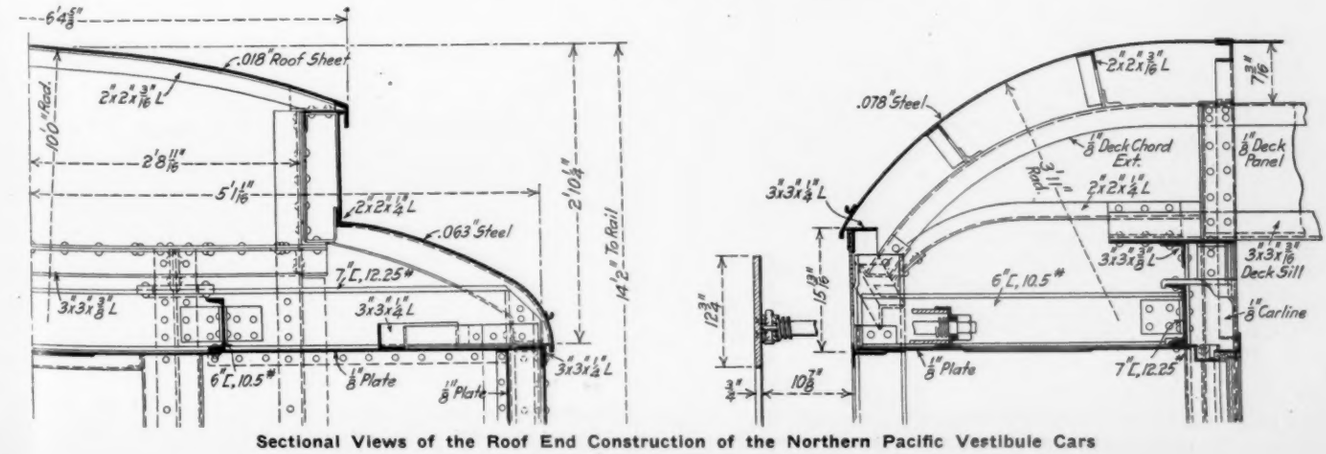
Section Through Vestibule Ends

There are two crossties, one 9 ft. 3 in. each side of the middle of the car. They consist of 3-in. by 3-in. by ⅜-in. angles, to which is riveted a ¼-in. plate. A top cover plate ⅝ in. by 6 in. and a

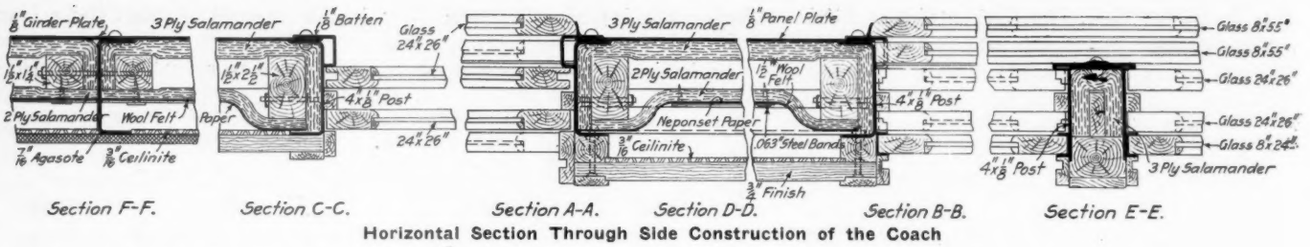
from end sill to end sill. To the lower leg is riveted a 4-in. by 3-in. by 5/16-in. angle, to which the outside sheathing is applied. The floor supports consist of 3/16-in. by 5-in. pressed



Section Through Dummy End Frame

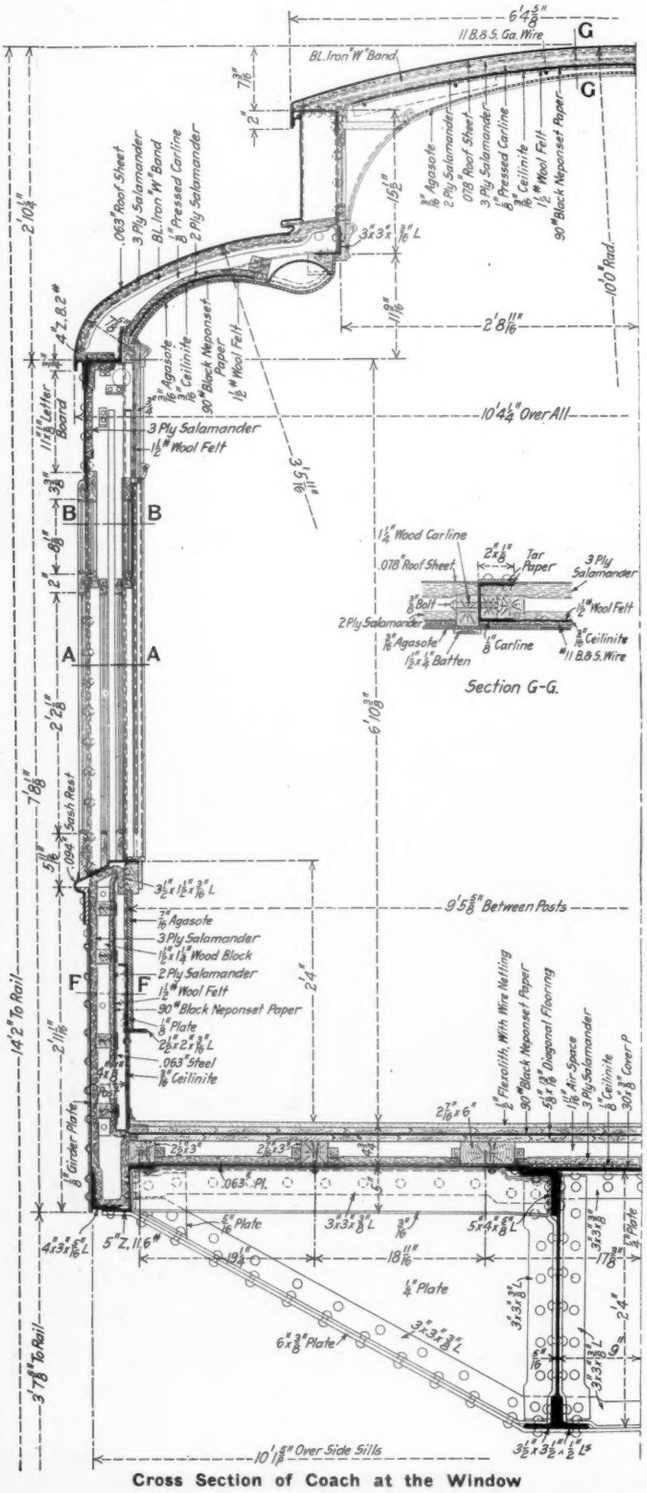


Sectional Views of the Roof End Construction of the Northern Pacific Vestibule Cars



Horizontal Section Through Side Construction of the Coach

steel pans, extending between the center sill and side sills. The underframe is covered with 1/16-in. plates. The end sills are ¼-in. pressed steel pans, 12 in. deep, extending between the side and center sills.

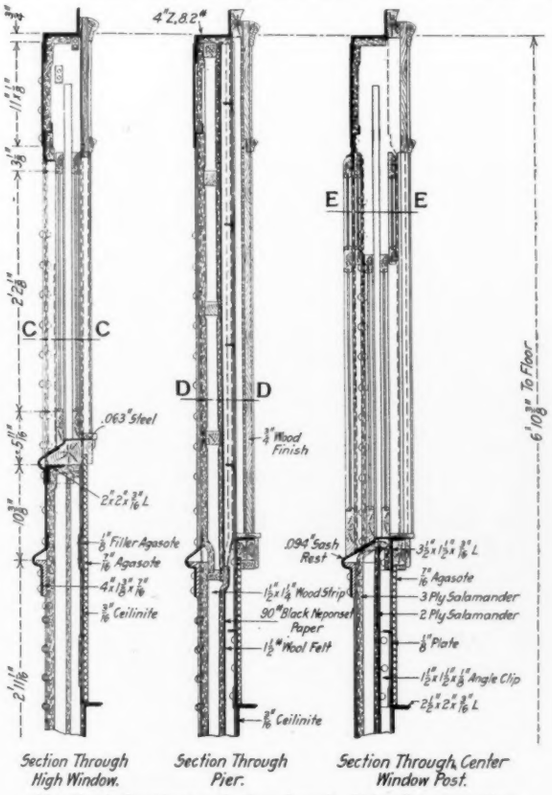


Cross Section of Coach at the Window

SIDE FRAMING

The general construction of the side framing in all types of cars discussed in this article is similar, the clere-story type of construction being used. The side posts are ⅛-in. pressed steel channel sections 4 in. wide placed with the backs at right angles with the side of the car. The side plates are 4-in., 8.2-lb. Z-bars. The upper and lower deck carlines and the deck posts are made of one piece of ⅛-in. steel plate pressed in the form of a channel. The deck sills are 3-in. by 3-in. by 3/16-in. angles. The outside belt rails are 4-in. by 1⅜-in. by 7/16-in. dropper bars, and the inside belt rails are 3½-in. by 1½-in. by 3/16-in. pressed angles, both extending the full length of the car. The top of the outside belt rail is 2 ft. 11 1/16 in. above the bottom of the side sill.

In the vestibule ends four 6-in., 23.9-lb. I-beams form the door and vestibule diaphragm posts and four 4-in., 8.2-lb. Z-bars



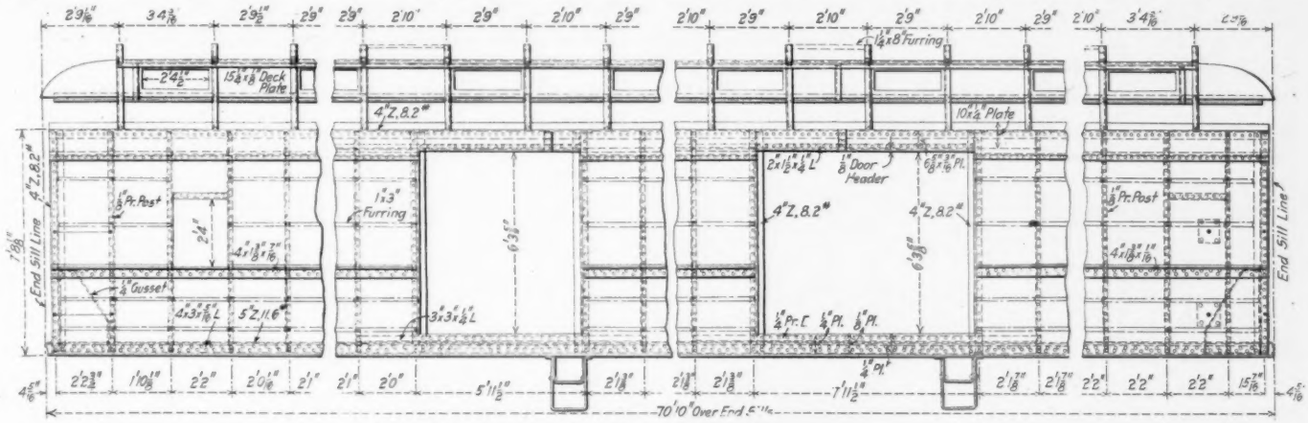
Vertical Sections of the Coach Side Construction

the intermediate and corner posts. The cast-steel buffer is mounted directly on the center sill and is further reinforced by a 7-in., 9.75-lb. channel 2 ft. 4¼-in. each side of the center line of the car. In the stub-end cars 12-in., 31.5-lb. I-beams are used for the door posts, and eight 4-in., 8.2-lb. Z-bars form the intermediate and corner posts, there being two corner posts at each corner. As in the vestibule end the buffer casting is attached directly to the center sill. An anti-telescoping plate extends across all sills back of the end sill.

INSULATION

The insulation for the floors of the coaches and diners consists of a layer of ⅛-in. ceilinite cemented to the steel sub-

floor and passing under the six floor stringers, a layer of 3-ply salamander, an air space, a course of Neponset paper laid between the two courses of 13/16-in. fir flooring and a layer of ½-in. flexolith with wire netting laid on the top course of wooden flooring. The insulation for the side and end walls consists of a layer of 3-ply salamander cemented to the inside of the steel sheathing, an air space, a course of 2-ply salamander, a layer of wool felt, a layer of Neponset paper, an air space and



Side Frame of Northern Pacific Baggage Cars

a layer of 3/16-in. ceilinite cemented to the inside lining. The insulation for the roof, including both the upper and lower decks, consists of a layer of 3-ply salamander cemented to the roof sheets, an air space, 2-ply salamander, Neponset paper, wool felt and a layer of 3/16-in. ceilinite. These cars are equipped with Baker heaters and the Gold indirect steam heating system with sufficient radiating surface to heat the cars to 70 deg., with an outside temperature of 50 deg. below zero.

Interior of Coach Taken Under Its Own Illumination

The insulation for the floors of the baggage, and mail and express cars consists of a layer of 3-ply salamander cemented to the steel sub-floor, an air space and a course of Neponset paper laid between the two courses of 13/16-in. flooring. The side and end walls are insulated with a layer of 3-ply salamander cemented to the outside sheathing, an air space, a layer of 2-ply salamander cemented to a layer of 3/16-in. ceilinite which in turn is cemented to the inside lining of 13/16-in. poplar. The upper and lower decks of the roof are insulated with a layer of 3-ply salamander cemented to the roof sheets. These cars are heated by the Gold direct steam heating system with sufficient capacity to maintain a temperature of 70 deg. with an outside temperature of 38 deg. below zero.

TRUCKS

Six-wheel trucks with structural steel frames are used under all the cars. They have a wheelbase of 11 ft., open-hearth steel annealed axles with 5-in. by 9-in. journals, 36-in. solid steel wheels and a distance of 7 ft. 7¾ in. from center to center of the Stucki roller side bearings. Cast-steel parts are used instead of forgings where practicable. Each wheel piece is made of one 9-in., 34.7-lb. channel reinforced at the top with a ⅜-in. steel plate. The end pieces are 5-in., 11.6-lb. Z-bars. The spring planks are 5/16-in. by 13½-in. by 5-ft. 6½-in. plates. The truck bolster is cast steel. The center plates of the car body and the trucks are positively locked against any horizontal movement, and in addition the car body and truck are securely held together by the Coleman center plate locking device. The center plate faces provide 116 sq. in. actual or 101 sq. in. projected area of contact and were machined and ground together to a smooth working fit. The benefits of this, combined with the use of roller side bearings, are readily apparent. The braking of the truck is of special interest. One piece cast-steel brake hangers are used and they are longer than those usually used on 6-wheel trucks. Two brake beams are applied to the middle pair of wheels and one beam to the inside of each of the outside wheels. The design prevents the back surge of the truck when it comes to a stop, the brakes applying with a slightly preponderant downward force on the rear of the truck. The brake beams are

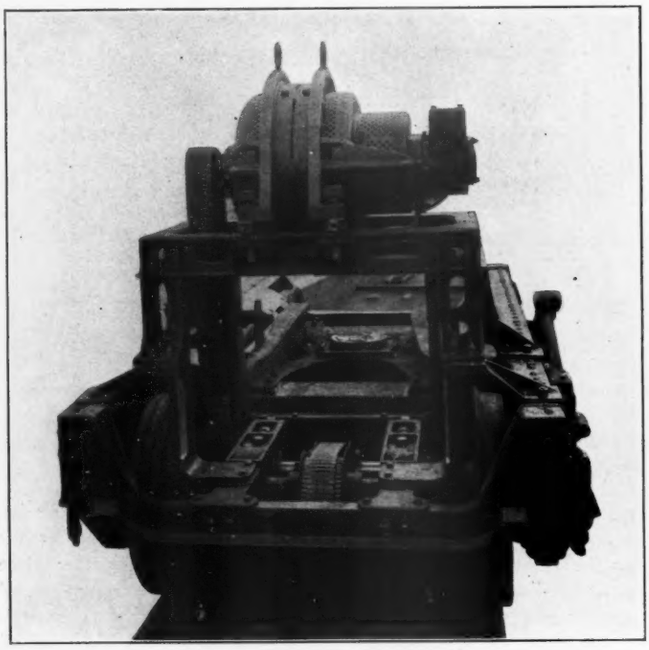
End View of Northern Pacific Steel Coach

designed to insure like pressures coming to both wheels on the same axle, maintaining the same relation of the brake head and shoe to the wheel, and provide an easy method for the removal

and reapplication of brake shoes. The braking power of the middle wheels is 32 per cent and for the end wheels 34 per cent.

LIGHTING

All cars are wired for the 64-volt, head-end electric lighting system, straight electric with candle-lamp auxiliary. The dining-



Axle Train Lighter Mounted on Truck

cars, dynamo cars and combination mail and express cars are equipped with 200-ampere-hour storage batteries. The electric wiring in all cars was installed in conduit. The dining-cars and coaches are equipped with a new system of car lighting which eliminates the projection of fixtures into the body of the

Axle Train Lighter in Northern Pacific Mail and Express Car

car. The new-style fixtures used were very carefully and accurately designed to give a large amount of light without glare. The illustration showing the interior of the coach was photographed at night with its own illumination.

Ten of the baggage cars and two of the mail and express cars are equipped with a 25-kw. steam turbine set with a switchboard designed to allow charging of the batteries during the lighting hours. Two of the mail and express cars are equipped with 17½-kw. axle machine train lighters. These are mounted directly on the trucks and are driven through a jack shaft from the outside truck axle. Steel castings extending between the truck end piece and the transom, 13⅞ in. each side of the center line of the truck and straddling the forward axle, support the jack shaft, and, together with the truck wheel pieces support the front foundation castings of the axle lighting machine. The back foundation castings are bolted directly to the truck transom, as indicated in the illustrations. The machine is driven by a Morse silent chain. A 45-tooth sprocket is mounted in the middle of the front axle. This drives a 31-tooth sprocket on the jack shaft and a 21-tooth sprocket on the jack shaft drives the 29-tooth sprocket on the machine. One of the photographs shows the machine inside the car. A heavy canvas webbing closes the opening in the car floor around the machine to keep dust and cold air out of the car. In service the machine and the opening in the floor are completely covered by a sheet iron casing.

An interesting feature in connection with the building of these cars is that the plans and specifications described the cars in such detail that builders were able to place orders for material as soon as they received the contract (December 4, 1914) and were thereby enabled to turn out the first cars February 20, 1915. These cars have been made up into new steel trains running between St. Paul and Duluth, between Spokane and Seattle and between Seattle and Portland. In addition to these, the Pullman-Northern Pacific Association has supplied 21 new steel standard sleepers for use in these trains.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION CONVENTION

The seventeenth annual convention of the Chief Interchange Car Inspectors' and Car Foremen's Association was held at Murphy's Hotel, Richmond, Va., September 14 to 16, 1915, F. H. Hanson, assistant master car builder, New York Central, presiding. The meeting was opened with an invocation by the Rev. J. J. Scherer, and the association was welcomed on behalf of the state of Virginia by Attorney-General John G. Pollard, representing Governor Stuart, and on behalf of the city of Richmond by Mayor George Ainslie. T. J. O'Donnell, arbitrator, Niagara Frontier Car Inspection Association, Buffalo, N. Y., responded for the association. President Hanson then delivered an address, calling attention to the greater uniformity of interpretation and improved enforcement of the rules of interchange resulting from the work of the association and laying stress on a number of conditions where further improvement is needed.

PRESIDENT HANSON'S ADDRESS

President Hanson spoke in part as follows:

The past year has been a very trying one for the managements of the railroads, compelling officers to spend much of their time studying new ways of economizing and reducing expenses without interfering with the quality of the service. Heavier power has been purchased with a view to handling a large number of cars per train and getting them over the road in as short a time as possible. This necessarily requires that all cars be in safe condition to be handled in such trains.

Some of the railroads are spending large sums of money equipping cars with steel underframes, friction draft gear, steel ends, etc., which materially assist in avoiding delays en route and keep the cars off the repair tracks. There are a large number of cars, however, that are not receiving these betterments and must be given careful inspection in order to know that they can be handled in such trains with safety; also to see that they are not cut out and sent to the repair or transfer track unnecessarily. Both of these considerations require

good, sound judgment on the part of the car inspector.

There is a general effort to reduce delays in the movement of cars. Delays are due to many causes, some of which will not be affected by any action we may take. Delays to cars in interchange and cars transferred, however, are matters over which we have some control. While a wonderful improvement has been made in the past year in reducing the number of cars transferred, there is still room for further improvement.

I note that the Arbitration Committee since Oct. 1, 1914, has prepared answers to about 150 questions, thus imposing a very heavy burden on this committee, as they cover 113 pages of the rules and 50 pages of interpretations. We should be more cautious in submitting trivial questions, thereby reducing the labor of the committee. With this end in view, would it not be advisable to appoint a special committee or make it a part of the duty of the executive committee to see that representatives of the M. C. B. Association arbitration committee, American Railway Association bureau of explosives and other similar organizations are invited and urged to attend our meetings?

The enforcement of the loading rules is now quite generally insisted on and has resulted in expediting the movement of traffic and decreasing claims for loss and damage to lading; yet the railroads in 1914 paid claims amounting to $32,375,617, a material proportion of which might have been saved had the shipments been properly packed and secured. The education of the shipper to comply with loading rules is an important matter. It is not the intention of any railroad to impose hardships on the shippers or to antagonize them in any way. If representatives of the mechanical department make it a point to call on those who hesitate to comply with the rules and show them the danger involved when the rules are not complied with we will have very little trouble in securing compliance.

Another matter that should be given careful attention is defective brake beams and parts. A great many cars are now in service with parts worn to such an extent that they are absolutely unsafe. All roads should go into this matter very thoroughly by giving these parts special inspection as cars pass over repair tracks.

A few months ago a vigorous campaign was started by the railroad I am connected with. It was found that 95 per cent of our brake beam troubles were in the brake head, brake hanger and the brake shoes; the loop hanger brake heads were the worst. Several special men have been placed in all our large yards to make special examinations of trucks in every instance when this could be done, not only on repair tracks, but in yards as well. The result is that we have a miscellaneous assortment of brake heads, brake hangers, brake pins, etc., amounting to between 60 and 90 tons, removed at three important yards on the New York Central, Lines West.

H. Boutet, chief interchange car inspector, Cincinnati, Ohio, briefly sketched the development of the association and brought out the fact that a gain of 61 had been made in membership during the past year. Letters were received and read before the convention from D. R. McBain, superintendent motive power and rolling stock, New York Central, Lines West, who is president of the Master Car Builders' Association; J. J. Hennessey, master car builder, Chicago, Milwaukee & St. Paul; F. W. Brazier, superintendent rolling stock, New York Central, and James Coleman, superintendent car department, Grand Trunk, members of the arbitration committee of the Master Car Builders' Association and W. F. Schaff, superintendent, New York Central, Cleveland, Ohio. Mr. Hennessey called attention to the necessity for great care in making joint inspections, stating that cases had come to the attention of the arbitration committee where such inspection reports had been signed when the actual inspection had not been made by both inspectors.

MR. SCHAFF'S LETTER

In his letter Mr. Schaff said:

"I am particularly in sympathy with the work of your association because my experience in the operating department has taught me the necessity of co-operating with your men in transportation work. It should be remembered that every man is an important integral part of the corporation by which he is employed, and his success depends upon his conscientious efforts to present inviting service to the public. Primarily, we are in this business to sell transportation, and upon its quality depends the amount of business we shall secure. Every man should feel himself a freight solicitor, whether he is making way bills, spiking rails, inspecting or building cars; his work should be done with the thought in mind that he is improving the quality of transportation we are inviting the public to accept. It is our duty and should be our purpose in doing our work to let no opportunity pass to invite the good will of those who want to use our service.

To this end we should familiarize ourselves not only with the work of our own department, but seek to intelligently conduct our own affairs so as to render assistance to those we work with. When business is once secured it is our obligation to perform the transportation as advertised, bearing in mind that net earnings are to be conserved. It is easier to conserve the net earnings if good equipment is furnished in the first place that will carry the load from originating points to destination with the least possible delay. Every time a car is cut out we tax the revenue. It is evidently true economy to spend money at the originating point rather than to make continuous expenditures en route.

"At interchange points an intelligent inspection is worth the price of a day and night engine crew. The inspector at the junction must determine when the cars are safe to run, and if not, where repairs should be made and whether transfer is necessary. In making these decisions he must consider the mileage the car has yet to make, the kind of road it is going over, the character of lading and the train service in which it will probably move. It has been my experience to see inspectors reject cars at interchange points with apparently no knowledge of the yard switching involved and no consideration of the movement of service. On the other hand, it has been my privilege to be associated with inspectors who took a vital interest in seeing that a proper inspection of the car was made at the point involving the least expense in switching and the least expense in moving to and from shop yards."

TRIFLING DEFECTS IN INTERCHANGE

The following paper on the problem of small defects in interchange was read by H. Boutet, chief interchange inspector, Cincinnati, Ohio: Interchange of cars, especially at large interchange points, is one of the serious problems of railroading and one which requires a great deal of thought, not on account of the serious defects that exist on cars, but because of the trifling ones, which would not be repaired if the cars were at its own shops.

Some of the inspectors imagine that the number of defect cards they get from the delivering line is what determines their value to their company. This is not the case at a few places, but all over the country. If a defect card is issued at one point the movements of the car are traced and the inspector who received the car on that line is asked to state why a card was not secured by him. Continually receiving such letters, the inspector makes up his mind that defect cards are what his company wants, and as he is desirous of holding his position, he falls in line and demands cards for all cars on technicalities.

Let us go home firmly resolved to work to the common sense view of the M. C. B. rules as interpreted by the arbitration committee. We should instruct our inspectors that we are not looking for every twenty-five-cent piece that we can compel the delivering line to be responsible for through a technicality, but have them look only for the serious defects—anything that will affect the safety of the handling of cars as to train movement, train men and the lading. If we will do this we will save a vast

amount of money each year that is now being wasted. While we are holding delivering lines for the small defects we are compelling them to do the same thing against our own line and compelling the inspectors to use more time in making the inspection. There is too much time lost in looking for and carding for trifling defects that do not affect the safety or usefulness of the car. This is a serious matter, especially in crowded terminals, where it is absolutely necessary that the cars be kept moving to prevent the terminals from becoming blocked. But the most serious part of it is that it causes the inspectors to overlook defect that should be seen and cars are not set out that are liable to cause trouble.

Count the cars that go through your terminals for a week and note the number carded for from two to thirty siding boards and side facia boards raked and broken or roof boards damaged; examine the defects and you will no doubt find that siding boards and facia boards raked through the paint are scratched by the nails in the door, that the roofing boards have the edges outside of the facia raked on house cars, and similar defects on coal and flat cars. Defects of this nature are causing more trouble in the interchange of cars to-day than anything else. There is not a member of this association who does not realize that it costs more to collect on many defect cards than the face of the card calls for. This is surely not making money for the companies we represent.

It will take an inspector five minutes at least to make out a defect card and tack it on a car. With from three to five cards to a cut of cars, they have been delayed fifteen to thirty minutes, and you cannot delay a switch engine and crew for less than 10 cents per minute.

I have not mentioned any of the other delays that may be caused in the yards by this individual delay; sometimes two other crews have been delayed, not only in your own yard, but in the other yard as well.

Discussion.—The importance of eliminating the practice of carding cars in interchange for small defects was recognized. The greatest difficulty in accomplishing this is found at the large interchange points, where, owing to the number of roads involved, it is more difficult to establish uniformity of practice than at points where two roads interchange. At the larger points improvement must come through the efforts of the chief interchange inspector. At Cincinnati unnecessary carding has been greatly reduced and uniformity of carding secured by means of a school for inspectors conducted by the chief joint inspector. This school is held once a month, and all inspectors are required to attend by their foremen. An evening session is held for the day inspectors and a morning session for the night inspectors.

SUGGESTED CHANGE OF ORGANIZATION

W. B. Elliot (Wiggins Ferry Company) read a paper in which he advocated a reorganization of the association on broader lines. He suggested that the association be made a central organization to include all local car and inspection associations as subsidiaries. Many subjects of general interest are considered at the meetings of the local associations and some of these could profitably be taken up by the larger organization at its annual meeting. The proposed plan would make the larger association a clearing house for all car department matters of interest to foremen and inspectors, and a selection of questions for general consideration could be made from those brought up during the year in the local associations.

DISCUSSION OF THE MASTER CAR BUILDERS' ASSOCIATION RULES OF INTERCHANGE

Rule 2.—The question arose as to the propriety of rejecting an overloaded car under paragraph *c*. In this connection it seemed to be the general opinion that the term "improperly loaded" does not apply to overloaded cars and that the rejection of such cars lies with the operating department and not with the mechanical department. Considerable discussion took place as to the advisability of maintaining special agreements at variance with this rule and American Railway Association rule 15. This practice was defended on the grounds that under certain local conditions the rules cannot be successfully applied and that special agreements are therefore necessary. The association, however, adopted a resolution in favor of abolishing all special agreements modifying rule 2 and American Railway Association rule 15 after October 1, 1915.

At some points the use of the bad order return when empty card is used to allow cars to be sent forward to destination without transfer in order that cars not sufficiently defective to justify transferring the lading may be kept within the jurisdiction of the mechanical department and reloading at destination prevented. In some cases this practice is abused, however, and cars are allowed to proceed which are going long distances and ultimately have to be transferred before reaching their destination. According to the interpretation on page 7 in the 1915 revised rules, however, this card is intended for use when the load is destined to a point inside of the switching district, and a motion was made and carried that this interpretation be accepted by the association.

Rule 3.—The members were in doubt as to the application of paragraph *f*, requiring the application of brine tanks after October 1, 1916, to refrigerator cars in which salt is used with the ice. The opinion was expressed that the application of this rule depends entirely upon the product with which the car is loaded and that enforcement of the rule against cars loaded with products not requiring the use of salt with the ice would not be justified. As this section of the rule does not go into effect until next year it was referred to the executive committee with instructions to provide the information necessary to define the application of the rule.

Rule 21.—A question was raised as to whether this rule applied to rack cars with open tops used in handling coke. The opinion was that such cars do not come within the meaning of this rule. Where they were not originally equipped with running boards this rule does not justify the application of running boards at owners' expense.

Rule 42.—The change in the footnote under this rule left many of the members in doubt as to whether owners could be held responsible in case of three or more broken end posts where some of the posts are decayed. The footnote in the revised rules clearly applies to such combinations in the case of longitudinal sills only, but many of the members follow the practice of billing the owners for such defects where the decayed condition of the posts is sufficient to have been responsible for the failure of the car end. It was the belief that where the joint evidence plainly indicated the existence of such conditions car owners would accept the responsibility. However, since the wording of the footnote is plainly applicable to sills only and therefore refers to rule 41 rather than to rule 42, the association went on record favoring the placing of the footnote under rule 41 and its application to that rule only.

Rule 43.—Doubt was expressed as to the responsibility of the owner for damages to the superstructure of a steel underframe or all-steel car due to the failure of the underframe for which the owner is responsible in accordance with this rule. It is general practice to handle such cases as owners' responsibility accompanying the bill with joint evidence. Rule 48 was considered as applying in such cases.

Rules 58 *and* 59.—In the discussion the question came up as to the interpretation of these rules in case an air hose is torn off. Under rule 58 missing air hose is delivering line responsibility, while under rule 59 torn air hose is owners' responsibility, and there was some difference of opinion whether a hose torn off at the nipple on a car offered in interchange would be considered as a missing or a torn hose. At certain points a hose torn off is considered as owners' responsibility on the grounds that no one knows anything about how the hose was torn off and therefore cannot state whether due to unfair usage or to

the worn condition of the hose. The missing coupling lost with the hose is charged to the delivering line, since it has the coupling in its possession. Another interpretation was that the road having the car in its possession has a right to charge the owner for a hose torn off, but when delivered to a connecting line the delivering line should be held responsible. On motion this interpretation was approved by the association.

Rule 120.—The question was raised as to whether the labor cost of repairs was not to exceed 10 per cent of the base price given in rule 116, or whether depreciation was first to be deducted from the base price. The base price is used, no depreciation being allowed.

In the case of four or more longitudinal sills requiring renewal or splicing the car would be handled in accordance with the footnote under rule 42 unless the labor cost of making the repairs exceeds 10 per cent of the cost price of the car body, in which case it would come under this rule.

OTHER BUSINESS

The president announced that the executive committee was considering plans for increasing the scope of the work done by the association in order to more generally cover the car department field. It has been decided to offer prizes for the best papers on "Apprenticeship in the Car Department," the papers to be presented before the association at its next convention, and a committee will be appointed to conduct the competition. For the best paper a prize of $25 will be offered; the second prize will be $15, and the third $10.

The report of the secretary-treasurer showed that the membership of the association is now 382. The treasury has a balance on hand of $184.85.

The following officers were elected for the ensuing year: President, A. Kipp, general car inspector, New York, Ontario & Western; vice-president, W. J. Stoll, chief interchange inspector, Toledo, Ohio; secretary-treasurer, W. R. McMunn, general car inspector, New York Central. The following were elected members of the executive committee: Z. B. Wilson, Southern Railway; C. W. Mattox, Chesapeake & Ohio; A. Armstrong, chief interchange inspector, Atlanta, Ga.; C. J. Stroke, New York Central, and W. M. Halbert, chief interchange inspector, East St. Louis, Ill.

STEEL CAR DESIGN FROM A PROTECTION STANDPOINT*

BY JOHN D. WRIGHT
General Foreman Painter, Baltimore & Ohio, Baltimore, Md.

In the construction and design of steel passenger equipment cars, so many features are of more importance than the painting that it is not surprising if it receives little consideration on the part of the designer. Both the design and construction, however, have a direct influence on the paint coatings which are applied to protect the metal, and they, in turn, determine, in a large measure, the life of the vehicle. If no protective coatings of any kind were applied to a steel passenger car it would, in a few years, be almost a total loss from corrosion. Steel passenger equipment cars have now been in service long enough to develop their weak points, and show the parts susceptible of improvement, and, so far as the relation of the design and construction to the preservation of the metal is concerned, our observations have brought us to the conclusion that steel roofs, decks, deck screens, sash and doors are the principal parts to be considered in a paper on this subject. We might add that some modifications have already been made in these features.

Experience has taught us that a canvas roof, if properly applied and painted at the outset, is more easily preserved than the all-steel roof, and it can remain longer in service without being repainted. If, for any reason, the regular shopping period of the cars is prolonged, canvas roofs may be neglected without serious consequences, but this is not the case with the steel roofs, for they must receive attention at regular intervals, and be repainted at the terminal yards if the cars cannot be sent to the shops, in order to keep them from rusting. A number of all-steel car roofs have been constructed with raised expansion joints, the vertical surfaces of the joints being about 1¼ in. in height. The abrasive action of the cinders soon wears off the protective coatings from these joints, exposing the metal. Though steel cars have only been in service a few years, the writer has already seen roofs on which the vertical joint strips were worn and eaten almost entirely away by the action of the cinders and corrosion. Trouble of this kind may be overcome somewhat by frequent painting and sanding, but this will not protect the joints indefinitely. And it is not always convenient to paint them, especially on the cars operating on branch lines, or running in and out of foreign terminals. For these reasons we feel that steel roofs with joints projecting as little as possible above the main surface of the roof sheets are much better adapted to the protection afforded by paint coatings.

In the construction of steel passenger equipment cars it was quite natural to adopt many of the features of the prevailing wooden cars, so a number of steel cars have been built with hinged deck sash and screens for ventilation. Others are constructed with stationary deck sash and ventilators, and quite a number with the arched roof and ventilators, omitting the decks and deck sash entirely. On the wooden cars, the deck screens and hinged deck sash for ventilation appeared to work out satisfactorily, as a majority of the wooden cars were so equipped. But on the steel cars, the deck screens are objectionable because they form pockets in which the gases from the tunnels, and the cinders and moisture collect, to destroy the paint coatings and in this manner start corrosion. They are furthermore objectionable because the corrosion taking place back of the screens cannot be detected without going to the trouble of removing the screen frames. The employees at the terminals may notice rusting on the parts easily seen and repaint the roofs and the outside parts of the screen frames, but the hidden parts, which are not so accessible, are apt to be neglected until the cars are sent to the shops for classified repairs. And considerable damage may be done before the cars are returned to the shops.

Considering the improved methods of ventilation in use during recent years it would appear desirable to construct steel cars without deck screens and use the ventilators in place of the deck sash for ventilation. This would make them better adapted to the protection offered by protective coatings and also decrease the expense connected with the breakage of deck glass. Better still, from this point of view, is the arched roof with ventilators, as it does away with the deck sash entirely, and the corners, pockets and projecting surfaces common with the deck or clere-story construction.

There does not seem to be much trouble in properly protecting the exterior bodies of steel cars with the methods of painting already in use, but for both the exterior and interior finish, the use of smooth, level steel sheets is strongly urged in order to reduce the number of coats of surfacer, and the amount of glazing and putty of various kinds, to say nothing of the sandpapering and rubbing necessary to secure a good, finished surface. Rough sheets require too much paint material to make a level surface, and the heavy coating applied tends to reduce the life of the paint body. Furthermore, the protection afforded is gaged by the thinnest part of the film, where the surfacer may be rubbed or sandpapered almost entirely away, and not by the thick coating hanging in the rough parts of the steel.

The writer has seen a number of steel sash that have failed completely in a few years and from this, in connection with the fact that the other parts of the cars were in good condition, it would appear that steel sash cannot well be protected

* Presented at the forty-sixth annual convention of the Master Car and Locomotive Painters' Association.

by the use of paint coatings. Brass or copper sash, which need no protective coatings, may prove economical and practical, and may eventually take the place of both wood and steel sash in the steel cars, but from the fact that the ordinary steel sash are hard to protect from corrosion, they do not seem to be an improvement over the wood sash for use in steel equipment. Certain types of steel doors have rusted out entirely after a few years' service, though other types seem to be giving satisfaction. Modifications in the design of the doors that fail from corrosion will have to be made to assist the paint coatings in the protection of the metal. The change from wood to steel passenger equipment cars has been so rapid that it would not be surprising if experience eventually proves that a number of parts which gave satisfactory service on the wooden cars will be better adapted to meet the demands of steel equipment if they are changed somewhat in design and construction.

PIECE WORK FOR THE PAINT SHOP*

BY H. HEFFELFINGER
Foreman Car Painter, Pennsylvania, West Philadelphia, Pa.

The most equitable method to follow in fixing piece work rates for the application of any coat of paint or varnish, or such operations as puttying, knifing, filling, sandpapering, rubbing and striping to be done either to the interior or exterior of passenger equipment cars is by measurement. The measurement should be on what the foreman painter feels sure is a fair price to pay for each separate operation including striping, when done in bulk, for example, all over the body outside of an open end, of the smallest passenger car handled. The deck, roof, platforms, hand rails, underframe, tanks, trucks, etc., should be rated separately. Good judgment gained by personal experience and the maximum time it takes to do any separate operation, including time to get material, place scaffolding, etc., when paid for by the hour rate, should be the basis to set rates fair to the company and employees. Consideration should be given both to the fast and slow workmen, since both can do good work. The workmen should not be limited as to their daily earnings but allowed to make all they can, providing their work passes inspection.

Assuming that prices have been fully agreed upon for the smallest passenger, baggage or express car, measurement should then be taken, which is easily done by getting the square feet in the sides and ends of the car, deducting the area of the window and door openings. The price per square foot can then be calculated from the price fixed for each separate operation when done in bulk. This price can be used for all sizes of cars.

The price per foot for either size, gold or color lines, should be based on the price set for running these lines over the entire body. The letters and numerals of railroads are generally of a standard size and style, which permits the outlines being pounced on and the work done by the pencil hands who do the striping. From the price set for each letter or numeral can be figured the price per car. From this basis larger or smaller letters or numerals can be rated when laid out by pattern. Having the rate per square foot for each operation, excepting lettering and numbering, the price to be paid for either the upper or lower half of one side, the facia board, letter board, panels between windows, belt rails, corner posts, etc., can be easily determined. The same practice of measurement can be carried out on the inside of the car, not including the headlining and floor, which should be measured separately. There should be a fixed rate for the application of each coat of paint, varnish or whatever operation is required, say to finish one sash, blind, curtain runner or seat frame. The rate for each operation to be based on the time it takes to do each piece or a full set. Before setting piece work rates a shop should be well organized with established day or hour rates, which should govern the piece work rates according to the class of work performed, whether it be by a pencil hand, brush hand, rubber or laborer.

Printed Forms.—Printed forms should be issued, one to check up the piece work accounts, showing on the front the serial number of the card, to whom issued, date of issuance, date work completed, the number of operators, the charge number, the number of pieces, the number of operations, piece work prices and the total amount. It also should be noted whether or not the work is inspected and by whom. The back of this card should show the names of the workmen, the number of the workmen, the time on and off, the number of hours, the total hours day work, with rate per hour, the amount and the word "correct" with space for the signature of the foreman. A card of this description should be used mostly for giving out work in bulk.

A second card should be printed showing the serial number, the charge, the date the work was issued and completed, the time on and off, the names and numbers of the workmen, the hours, the total hours, the hourly rate and amount, with the word "correct" and a space provided for the signature of the workman. On the back of this card there should be left a place for the name of the gang leader, the total number of pieces, the rate and the amount, together with a space for the numbers of the cars worked on, also a space for the kind of operation, with the prices.

A chart should be printed showing the price for each individual operation, such as doors, inside and outside, seat frame, etc. Another chart should be made of the same description with spaces left blank to write in the operations that have been authorized but have not been printed.

When all the work has been completed it should be inspected and checked from the card by the persons issuing the card, if possible, and frequently by the foreman and assistant foreman. After the work is completed and the cards have been approved by the foreman, they are turned over to the piece work clerk, who separates all the charges and pro-rates the money by the time made and enters it in a book provided with a column for each person's account.

*Abstract of paper presented at the forty-sixth annual convention of the Master Car and Locomotive Painters' Association.

COKE REPLACING COAL IN SWEDEN.—Sweden's importation of German coke is reported as exceptional recently. It is caused by the high prices of coal in England and the freights. Many Swedish steamers as well as state and private railroads are now using coke, either alone or mixed with coal or wood, with apparently good results as coke imports are continually increasing.—*Iron Age.*

NOISE AND ACCIDENTS.—Fatigue has a notable influence in causing accidents, and anything that will tend to reduce or increase fatigue among workers should therefore receive consideration. Noise, for example, should have a prominent place in the list of items accredited with the production of fatigue. Loud noises, even though produced for only a short time, irritate the average person; and if they are continued all day, and every day, they may have a serious effect on the nervous system, and become a potent factor in causing fatigue. The older employees in a noisy shop become more or less accustomed to the noise, and often can readily detect any new or unusual sound. New men are likely to be confused by the constant loud noise and the strangeness of their environment, and are less likely to note warning sounds. When the din in a shop is so great that a workman must shout into his companion's ears in order to be heard, it must needs be a sound very much out of the ordinary to draw his attention to danger and keep him out of harm's way.—*Travelers' Standard.*

SHOP PRACTICE

REPAIRING DRIVING BOXES

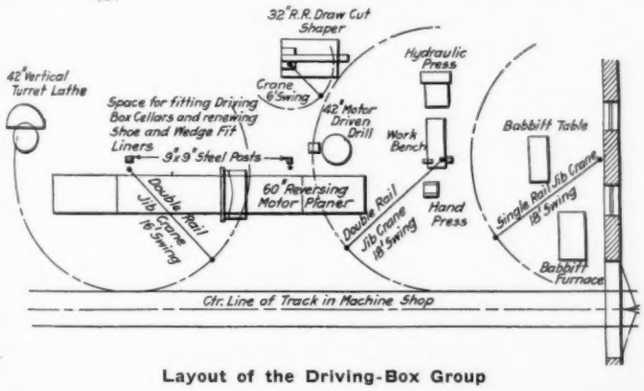
BY P. F. SMITH
Mechanical Engineer, Chicago, St. Paul, Minneapolis & Omaha, St. Paul, Minn.

Owing to the constant delays which were being experienced in getting out driving box work at the St. Paul shops of the Chicago, St. Paul, Minneapolis & Omaha, it was decided some time ago to make some radical changes in the method of handling this branch of locomotive repairs. Accordingly, all the tools and accessories used were regrouped in one end of the machine shop so that all operations may be performed with a minimum amount of handling.

The equipment used is shown in the following list:

60-in. Niles-Bement-Pond motor reversing planer.
32-in. Motor shaper, motor driven.
42-in. Bullard vertical turret lathe, motor driven.
42-in. Barnes drill, motor driven.
Hydraulic press for forcing in and out driving box brasses.
Hand-operated screw press for closing driving box brasses.
Babbitt furnace for melting babbitt.
Babbitt table consisting of a cast-iron face plate.
Three jib cranes.

By referring to the layout of the group it will be seen that the babbitt furnace and table are served by one of the jib cranes,


32" R.R. Draw Cut Shaper
Hydraulic Press
42" Vertical Turret Lathe
Crane 6' Swing
Space for fitting Driving Box Cellars and renewing Shoe and Wedge Fit Liners
42" Motor Driven Drill
Work Bench
Babbitt Table
9"x9" Steel Posts
60" Reversing Motor Planer
Double Rail Jib Crane 16' Swing
Double Rail Jib Crane 18' Swing
Hand Press
Single Rail Jib Crane 18' Swing
Babbitt Furnace
Ctr. Line of Track in Machine Shop

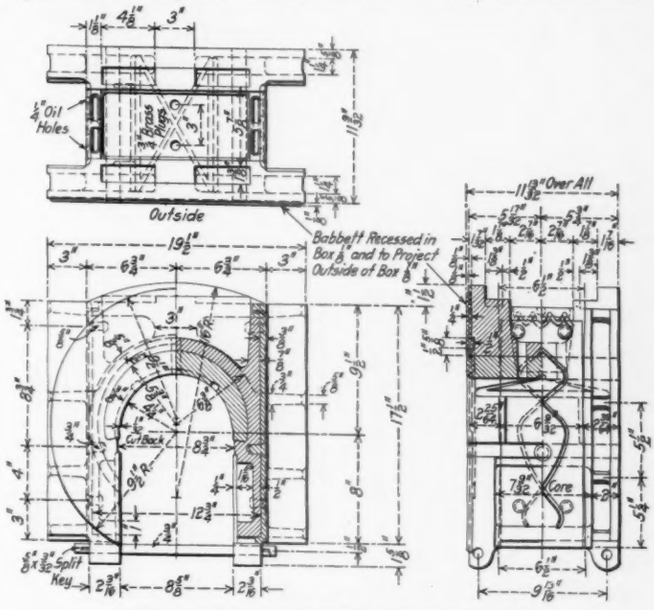
Layout of the Driving-Box Group

having a swing of 18 ft. Another 18-ft. crane serves the presses, the work bench, the drill and the planer, while a 16-ft. crane serves the planer and the turret lathe. The shaper has its own crane, which has a swing of 6 ft.

Part of the boxes repaired are of a standard design of cast steel, with removable brass liners on the shoe and wedge faces and inset hub faces of babbitt metal. A drawing of one of these boxes is shown. It is the front and back box for a 21 in. by 26 in. 10-wheel engine, and with the exception of a few minor details differs from the main driving box only in the diameter of the journal and brass fit in the box. In the main driving box these dimensions are one-half in. larger. The lubricant used is grease and the brasses are of Ajax plastic bronze. The grooves for feeding the grease in the bearing faces of the brass and the shoe and wedge liners are cored to save chipping when fitting the boxes to the axles. The liners are fastened by four ⅝ in. copper rivets and a ¾ in. copper threaded plug, in addition to top and bottom lips. They are finished for a standard distance from face to face of 13½ in., but when new liners are applied this is increased to 13⅝ in., which permits of two shoppings before they are scrapped. The hub face of the box has a double dovetailed groove which securely holds the babbitt hub liner, and the brass is held through the crown by two ¾ in. taper brass plugs which are driven in tight.

In order that the method of procedure may be made clear a set of boxes for a 10-wheel engine, similar to those shown in the drawing, will be followed through the shop from the time they come out of the lye vat until they are ready to be put back under the locomotive.

The boxes are moved from the lye vat to the machine shop on a push car. They are then examined to determine the extent



Type of Cast-Steel Driving Box Handled

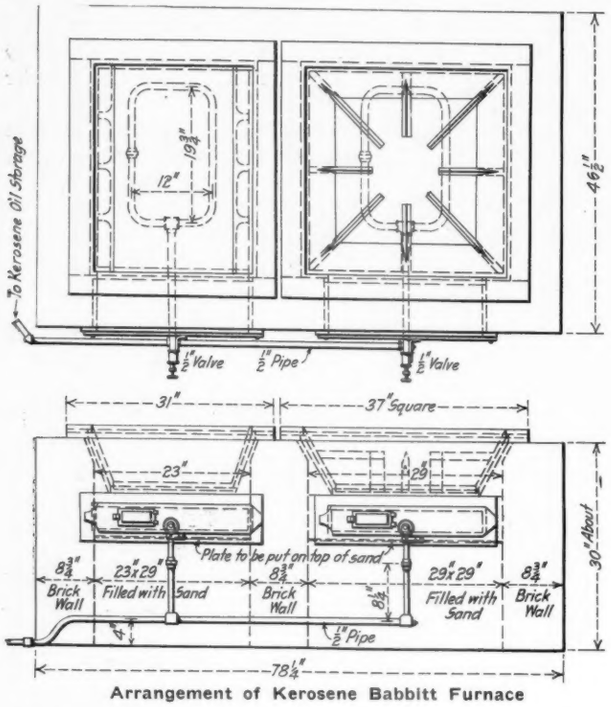
of repairs necessary. If there is sufficient metal in the crown of brass they are marked for closing. If any are worn to the condemning limit in crown they are marked for new brasses, after which all the brasses are removed in the hydraulic press. New brasses are never applied unless the old ones are worn to the limit, because of the high first cost of the Ajax metal.

In this case let us assume that the front and back brasses may be closed, but that the main boxes will require new brasses. After the old brasses are removed the boxes are taken from the

Babbitt Furnace, Showing Driving Box in Place for Removal of Hub Liner

hydraulic press to the babbitt furnace, where they are submerged hub face down in the hot babbitt contained in one of the melting pans. These pans are of cast iron and in one of them are a number of thin projections extending from the sides and corners

toward the center to serve as a support for the box. The old babbitt is thus removed and the box at the same time heated ready for rebabbitting. The boxes are next transferred to the babbitt table, where the new babbitt is applied, using metal formers. The handling of the boxes from the push car to the hydraulic press and from the press to the furnace and babbitt



Arrangement of Kerosene Babbitt Furnace

table is accomplished with two jib cranes, which are equipped with air cylinder hoists.

The boxes are now ready to receive the brasses and the time required to complete the operations so far performed is as follows:

Removing old brasses at hydraulic press, one man only, six boxes, at four minutes each	24 min.
Handling boxes from hydraulic press to babbitt furnace, removing old babbitt, rebabbitting and returning to hydraulic press ready to receive brasses, one man only, six boxes at 15 minutes each	1 hr. 30 min.

The Type of Hand Press Used for Closing Crown Brasses

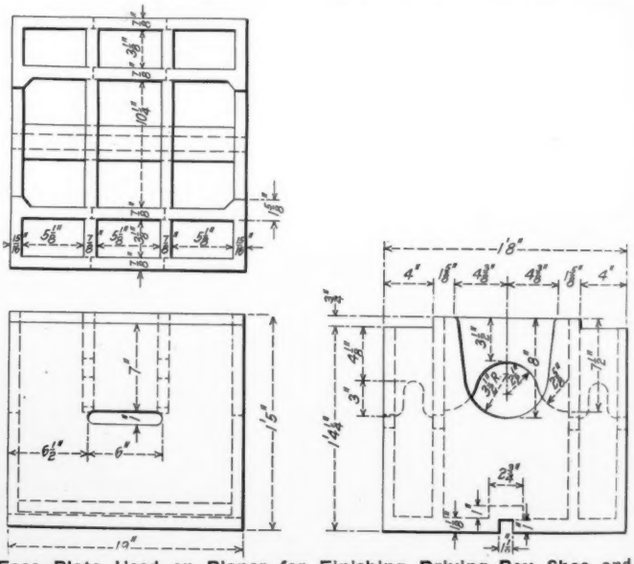
The new brasses for the two main boxes are selected by the shaper man from a stock of the various patterns kept on the floor adjacent to the shaper. These are finished to fit, the proper sizes being taken from the boxes at the hydraulic press. The press man then puts them into the boxes at a pressure of 35 to 40 tons.

The press man takes the four old brasses for the front and back boxes to the hand press and closes them in. This drops the crown and changes the angle at the bottom of the brass where it fits into the box. In order to get this fit correct he now chips down about one inch on the brass and makes a driving fit into the box, using mild steel shims of the proper thickness to fill above the crown. When a fit is obtained the brass is removed and finished on the shaper, using as a guide the part just finished by hand. After the brasses are reshaped the liners are applied and they are pressed into the boxes.

After the main boxes have been drilled and reamed to receive the crown plugs the boxes are ready to receive the cellars. While having the crown brasses reapplied they have been handled entirely by the jib cranes, and the following time has been consumed:

Shaping new brasses for main boxes, pressing them in and drilling for the crown plugs; 2 brasses at 40 mins. each	1 hr. 20 min.
Closing old brasses, making and drilling liners, fitting and shaping old brasses and pressing in ready for cellars; 4 brasses, at 40 mins. each	2 hr. 40 min.

The six boxes are now transferred to the floor back of planer, where the cellars and driving box saddles are fitted and the shoe and wedge liners examined. In closing brasses it sometimes spreads the box a trifle at the cellar fit and when cellars are found loose they are babbitted on the sides to make a snug fit with the box. The shoe and wedge liners, if loose, are tight-



Face Plate Used on Planer for Finishing Driving-Box Shoe and Wedge Faces

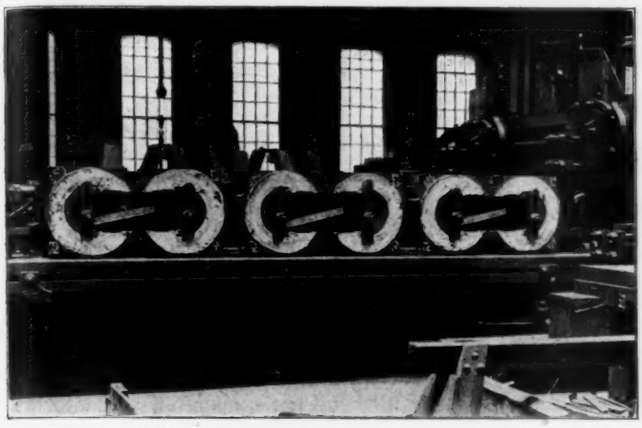
ened, if worn to the limit they are scrapped and new ones applied. Assuming that on the set of boxes under consideration it was found necessary to tighten the liners and babbitt the cellars, the time required is as follows:

Babbitting and refitting in boxes, six cellars, at 10 min. each	1 hr. 0 min.
Tightening liners and fitting driving box saddles, six boxes at 17½ min. each	1 hr. 45 min.

The boxes are next transferred to the 60-in. planer, where the liners on the shoe and wedge faces are planed. The planer is arranged so that twelve boxes can be planed at once, six lined up on either side of a box face plate, thus utilizing both planer heads. A detail of the face plate is shown in one of the drawings. This method assures perfectly parallel surfaces.

When the liners have been finished the boxes are transferred to the Bullard vertical turret lathe, where the hub face is finished and the brasses bored to fit the journals. The two operations can be accomplished at one time, but this practice is

not followed, as it would result in mixing the brass and babbitt chips. Both operations are performed, however, with the one chucking. The boxes are handled while at the planer and verti-



Driving Boxes Set Up on Planer for Finishing Shoe and Wedge Faces

cal turret lathe by a jib crane with air hoist trolley. The time required for the different operations is as follows:

Boring brasses to fit axles, including one roughing and one finishing cut, and relieving brass front and back 1/32 in., six boxes at 15 min. each	1 hr. 30 min.
Facing babbitt hub, six boxes, at 5 min. each	30 min.
Planing shoe and wedge faces, 1 roughing and 1 finishing cut, six boxes at a time	4 hr. 30 min.

The total labor time required to handle the entire set of boxes from the lye vat through the shop until they are ready to go on the axles, it will be seen, is 15 hr. 9 min. In every case the operations are performed by one man, the handling being done by the jib cranes.

A POSSIBLE SUBSTITUTE FOR ACETYLENE IN WELDING AND CUTTING

BY J. F. SPRINGER*

Gas welding and gas cutting have very fully proved their practical value, and to-day the question to be considered is not so much whether or not certain lines of work may be done with gas, but whether there may not be some way to cheapen the process. Oxygen is, and has been, the chief expense; it is advisable to have it pure, especially for cutting. Its price has been reduced during the past few years, but at present there would appear to be nothing in sight warranting us in expecting any further reductions of a radical character. The cost of acetylene depends upon the price of calcium carbide, and as one pound of carbide produces 4 or 4½ cu. ft. of acetylene and no more, there is not much prospect of reducing the acetylene cost below 1 cent per cu. ft.

Hydrogen is at the present time the chief competitor of acetylene. Where the installation of welding and cutting equipment is sufficiently large to warrant the use of an electro-generator to produce oxygen by the decomposition of water, hydrogen is generated as a by-product. Although produced in exactly the right proportion, theoretically, for union with oxygen, an excess of hydrogen must be provided, however, for practical use with the torch. The greatest usefulness of hydrogen is probably in cutting operations, especially on steel. If the cutting is a preliminary to machine tool operations acetylene is apt to carbonize a thin skin on the edge of the work and so harden the surface, while hydrogen has no such effect. For general use, however, especially in welding, the low thermal value of hydrogen as compared with acetylene, is very much in favor of the latter. The thermal value of acetylene is about 1555 B. t. u. per cu. ft., which is nearly five times as much as hydrogen.

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There is, however, a liquid gas product of certain kinds of natural gas which seems to promise a marked reduction in the cost of fuel gas for use in autogenous welding and cutting, especially for certain lines of work. The new gas seems to have originated through the development of the manufacture of natural-gas gasolene. This industry is now about 11 years old, dating from 1904, when gasolene was obtained in commercial quantities by simply collecting the liquid formed by condensation in pipes transmitting natural gas. The next step was the artificial chilling of the pipes, followed by low pressure, single stage compression. Two or three years ago the practice of carrying the raw gas through two stages of compression was introduced, the products being separated into two forms of gasolene. The product derived from the first stage is substantially the gasolene of commerce. The product of the second stage is a light, high-grade gasolene which is useful for blending with heavy naphthas, the final product being sold for automobile use.

The semi-liquid product which may be used in welding and cutting, is the yield of a higher-stage compression, and is so volatile that it should by all means be regarded and handled as a gas. A beginning has already been made in its manufacture. At Sistersville, W. Va., and Kane, Pa., are found natural gases which lend themselves to high compression and produce a semi-liquid of high thermal value. This product has already received a limited application in welding and cutting. In its semi-liquid condition, one pound produces, upon vaporization, 10 cu. ft. of gas. It is shipped in metal containers and it is considered possible to so proportion the container that 100 lb. of metal will hold 100 lb. or more of the fuel.

In the following table are given the various hydro-carbon gases to be found in natural gas, together with their heating value per cu. ft.:

Methane (CH_4)	1065 B. t. u.
Ethane (C_2H_6)	1861 B. t. u.
Propane (C_3H_8)	2654 B. t. u.
Butane (C_4H_{10})	3447 B. t. u.
Pentane (C_5H_{12})	4250 B. t. u.
Hexane (C_6H_{14})	5012 B. t. u.

The ordinary natural gas consists largely of methane, the heating value of which is low in comparison with acetylene. At Follansbee, W. Va., a natural gas is produced which contains no methane and is made up of approximately four-fifths propane and one-fifth ethane. This gas has a thermal value of 2,468 B. t. u. Experiments with this gas at various stages of compression indicate that the constitutents of higher thermal value are first liquefied leaving the others in the residual gas. When subjected to 400 lb. pressure per sq. in. at 32 deg. F., and revaporized a gas of varying quality was obtained. Of several samples taken at regular intervals, one was almost pure ethane, another almost pure propane. The lowest thermal value was 1,808 B. t. u., and the highest 2,621 B. t. u. The methane, which has the lowest heating value and is therefore least desirable in the semi-liquid product, requires a pressure of 2,700 lb. per sq. in. to cause it to liquefy, and is therefore not apt to be present in the product of compression under 400 lb. per sq. in.

From another set of experiments with Follansbee gas under 400 lb. pressure, it was found that samples drawn from the top of the same cylinder varied considerably in quality and heating value. This would indicate the necessity of constantly changing the regulation of the torch, which would be impracticable. However, it has been found that by drawing the supply for the torch from the bottom of the cylinder a gas of approximately uniform quality may be obtained.

It was previously stated that the semi-liquid product could be stored in containers holding an amount equal to their own weight. It is worth considering what this means in relation to its portability. The users of acetylene either manufacture their own gas in a stationary generator plant and pipe it to the points of use, or else use metal containers which hold a small weight of gas relative to the weight of the container itself. This advantage of the semi-liquid natural product is not only of value about

the shop but reduces the transportation charges. Each pound of semi-liquid occupies a space of 49 cu. in., and on expansion will produce 10 cu. ft. of gas the heating value of which is from 30 per cent to 75 per cent greater than that of an equal volume of acetylene.

The boiling point of the Follansbee product is — 40 deg. F., and at 32 deg. F. it requires a pressure of 400 lb. to maintain it in the liquid state. At 131 deg. the pressure is 755 lb., which is well within the present practice in handling similar products. If higher temperatures are apt to be met it will not be difficult to secure containers to withstand the higher pressures.

The new product has not as yet been applied extensively as a substitute for acetylene in welding and cutting operations, but a practical beginning has been made. It has found considerable use in shops in the Pittsburgh district, and there has been some application in Brooklyn. A special burner is needed, for the reason that the oxygen supply necessary is relatively larger than for acetylene. Accordingly, the gas inlets must provide for the correct practical ratio of the two gases. In burners using acetylene, the ratio between acetylene nad oxygen varies with the type of construction and operation and similar results may be expected with the new gas. However, it is not likely that any revolutionary changes in design will be found necessary. What does appear to be advisable is some means of reducing the high temperatures, as such temperatures tend to increase the difficulty with which certain lines of welding may be done. The practical use of the gas in cutting seems to mark it as especially suitable for this purpose; those who use hydrogen in preference to acetylene to avoid carbonization will not favor it.

Let us now consider the probable cost of the new product. The manufacture of natural-gas gasolene is now quite extensive. In the ordinary conduct of this industry a very considerable quantity of gaseous material goes to waste. This material contains some of the higher hydro-carbons of high thermal value which are subject to liquefaction or semi-liquefaction at moderately high pressures. The semi-liquid gas may therefore be compressed as a by-product of the natural-gas gasolene industry. The cost will not be influenced so much by the value of the gas as by the expense of carrying it through the higher stages of compression, and there is reason to believe that this expense will be about one-half cent per lb. Double this amount would be a fair price to the manufacturer. This price is just about one-tenth the cost of acetylene gas on a quantity basis. In addition it possesses a greater value because of its higher thermal value.

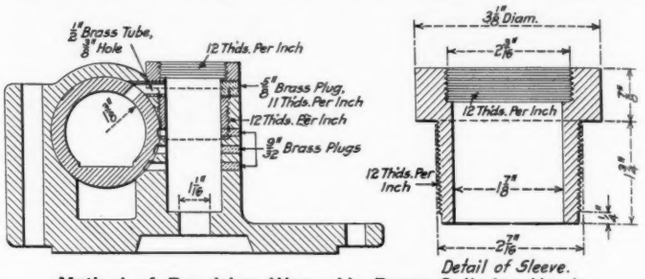
REPAIRING 9½-IN. AIR PUMP CYLINDER HEADS

BY BENJAMIN GRADY
Air Brake Foreman, Atlantic Coast Line, Waycross, Ga.

The accompanying drawing shows a method of reclaiming top cylinder heads for Westinghouse 9½-in. air pumps in which the reversing valve cap threads have been stripped or broken. The head is faced off ⅞ in., which is about half-way through the port which conveys steam from the main valve bushing to the reversing bushing. The inside of the reversing valve chamber is then threaded to a diameter of 2 7/16 in. and a depth of 1¾ in., the lower end of the threads passing through one of the smaller ports, as may be seen in the drawing.

After screwing in the steel bushing it is finished to the same height as the original head, the outside of the collar being left 3⅛ in. in diameter. A ½-in. hole is then drilled through the side of the reversing valve chamber, one-half of the hole being in the collar of the newly made bushing and the other half in the original head, thus opening up the port communicating between the valve chamber and the reversing valve chamber. A piece of ½-in. brass tubing, the inside diameter of which is ⅜ in., is then driven into this port and the outside hole is tapped and plugged with a ⅝-in. brass plug. This plug and the tubing serve as dowel pins to prevent the bushing from working loose. The small port near the lower end of the steel bushing is then opened up and the hole through the outer wall plugged with a 9/32-in. brass plug.

This method of repairing makes a stronger head than the



Method of Repairing Worn Air Pump Cylinder Heads

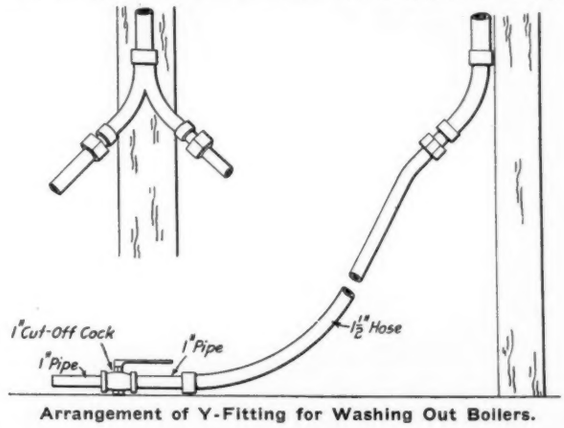
original, as the threads are in steel instead of cast iron, and a screw eye may be safely used to lift the pump off and onto the engine. This job may be done for about $2.50, whereas a new head costs $9, less all parts.

Y-FITTING FOR WASHING OUT BOILERS

BY PETER E. McINTOSH
Boilermaker Foreman, Michigan Central, Kalamazoo, Mich.

A special Y-fitting for use in washing out locomotive boilers has resulted in considerable saving in the cost of boiler washing at this point. The roundhouse is equipped with the hot water washing and filling system, and the special brass fitting is attached to the washout line near the engine, thus providing two lines of washout hose, one of which is fitted with a 1 in. cut-off cock at the nozzle.

When washing out a boiler the plugs are removed from the four firebox corners and one line of hose is placed in the front



Arrangement of Y-Fitting for Washing Out Boilers.

water leg, the other being placed through the front flue sheet washout hole. While this is in operation two boiler washers remove all plugs above the running board and the hose fitted with the cut-off cock is then used along the top of the boiler, beginning at the front flue sheet. By the use of this device it has been possible to dispense with the services of one man formerly required at the globe valve in the washout line.

Testing Piston Rods.—An electro-steel company has announced the results of a series of tests on piston rods made of the steel it manufactures. The steel showed a tensile strength of 123,775 lb. per sq. in., and an elastic limit of 82,600 lb., with an elongation of 24 per cent in 2 in. and a reduction of area of 53 per cent. In a revolution testing machine 984,933 revolutions were required to break the test piece at a stress of 30,000 lb. per sq. in. This steel, which contains manganese, is produced in an electric furnace.—*Power.*

How Can You Help the Apprentice?

The Prize Letter and Three Others Which Were Received in the Competition on This Subject

As noted elsewhere in this issue 18 letters were received in the letter writing competition on "How Can You Help the Apprentice?" Four of these, including the prize letter, have been selected for publication in this issue. The other letters, in whole or in part, will appear in the November and December issues.

SYMPATHY AND PRACTICAL CO-OPERATION
(PRIZE LETTER)

BY JOSEPH SMITH
Baltimore & Ohio, Lorain, Ohio

May I, as a voice from the ranks of the railroad boilermakers, make a few suggestions as to how apprentices should be helped? Any boilermaker who learned his trade in the days of the hand-driven rivet, the rolled flue and hand-chipped and calked seam will bear me out when I say that to very few of us were given the advantages the apprentice of to-day receives. In those days it was a case of hard knocks and labor before one could rise to the dignity of a hand-riveter or calker. How proud we were when told off for the first time to drive rivets with one of the old-timers. How our chests would swell when ordered to take the firebox end of a set of flues.

Then another step up was to hold the straight edge for the boss when he was laying out a piece of work. "See all those lines, a regular labyrinth ain't they?" And that's all we would know, for the boss was very careful of the secrets of laying out. A layer-out in those days was looked on as some one to pay homage to, and never a one did we find that was willing to let us into the light of things. I have indulged in this retrospection in the hope that some of the boiler apprentices would read these lines and be awakened to the fact that advantages are open to them to-day which will lead to the high road for promotion.

Now, Mr. Boiler Foreman, you have your apprentices. Having carefully sifted the material, you assure yourself that you have the most promising boys to make boilermakers out of. In the first place, rest assured that you have no college graduates among them; not, however, but what a few would help in the boiler department. Let the boys understand from the first that you are their friend, gain their confidence, but allow no tattler or tale-bearer in the bunch. Insist upon attention to details, even of the so-called unimportant points of the business. You will need lots of patience, but a little extra trouble with a willing boy pays in dollars and cents to the company.

You will have some who want to know the why and wherefore of different processes. You, out of your knowledge and experience, can make many things clear to them so that they will not get shown in the way the writer did when learning the business. In taking out some broken stay-bolts I came across one that was completely broken off at one end and partly broken on the other. I wanted to know why it was so, so I took it to the boss and said, "That's funny, isn't it?" "Yes," was the reply, "there's lots of funny things in this world." And that's all the enlightenment I got on that subject.

Your apprentices will get the practical experience in the shop, but something else is required, and that is the feeling of fellowship between them and their foreman. Let them feel that they are free to bring their little troubles to you, establish a bond of sympathy and helpfulness between them and yourself, and the day will come when your apprentices will be a credit to you and an invaluable asset to the company. Encourage them to study the technical details of their business at home; there are plenty of good books to be had on the subject.

Start a class in "laying out" in your shop, beginning with the simpler problems. An apprentice who studies in such a class will save much material, for he will not shear up a large sheet when a smaller one will do.

After twenty-three years in the business and a close observance of the different methods and results of handling the apprentice question, I believe that practical co-operation and sympathy with the apprentice will result in bringing the boiler department to a higher grade of efficiency.

THE VALUE OF INCENTIVE

BY J. CAMPBELL
Superintendent, Drifton (Pa.) Shops, Lehigh Valley Coal Company

April 1, 1915, I was appointed superintendent of the Drifton, Pa., shops of the Lehigh Valley Coal Company. At that time there were 19 apprentices employed; this number has been increased to 24, and will be further increased to 28, divided as follows: Three in the foundry, two in the pattern shop, one in the boiler shop, and the remainder in the machine shop, and two boys on probation in the car shop.

Our apprentices have for a number of years attended a school, under the supervision of the chief draftsman, every Wednesday from 12:30 to 1:30, the company paying them for the time spent in the class room.

I was strongly impressed with the intelligence and skill of some of the boys, and decided to do everything in my power to help them to a better education by endeavoring to arouse their latent energies in the direction of self-education.

We made the first effort in June by offering "one dollar" to the apprentice who would give the best suggestion as to how to repair a much distorted steel mine car frame which had been received for repairs; all answers to be turned in the next day in writing. To our surprise the boys took especial interest in the contest and nearly every one replied.

Anthony DeGrosse, a boy of 18, who had started his apprenticeship in the machine shop, May 1, 1915, presented a splendid pencil sketch with three pages of his own ideas as to how to repair the frame. He won the prize. There were so many good ideas presented that we decided to try again, and on July 22 offered "two months' time in any department of Drifton shops" to the apprentice giving the best suggestions as to how to repair a Jeansville pump to be on exhibition in the shops at the noon hour, or on idle days, permission being given to change the design of any broken parts, and also to give an approximate cost of overhauling the pump. All answers to be turned in one week later.

The boys became deeply interested and started at once to earn that change of position. Saturday following, being an idle day, they turned out in force and spent the morning on the pump, almost dissecting it to learn its condition. Two boys were on the job at 5:30 a. m.; one went to the Jeansville Pump Works, Hazleton, Pa., to learn about pumps, another to the colliery to examine the pumps, and by 10:00 a. m. they were nearly all studying and sketching the pump.

A committee of three, consisting of the foundry foreman, a draftsman and a master mechanic from one of our collieries, were appointed as judges. The contest was so close that it took the judges five hours to come to a decision.

Thomas D. Brobst, a young man of 20, serving his third year in the machine shop, was the winner. All the boys were commended for their work, and the management was urged to continue the contests. August 2 Brobst was started in the drawing room at his request. We now learn that the pump was the second style built by the Jeansville Company, and the first successful mine pump put in service.

We intend to continue these contests, and will also offer

prizes for the greatest improvement in penmanship and mathematics. We will try to stir the boys up to realize the need of a good general education to fit them for any position they may be called to fill in the years to come.

MODERN APPRENTICESHIP

BY ROBERT N. MILLER
Assistant Professor Machine Design, Carnegie Institute of Technology
Pittsburgh, Pa.

The success of any organization is dependent on the success of its individual units, and as such the mechanical organization of a railroad is dependent on the education and training of its men. One of the momentous questions of the day in connection with the efficiency of the mechanical department is not so much that of adequate supply of labor as the proper training of this labor so as to develop into the best mechanics for the future. The apprenticeship system of any organization can be divided into two chief divisions.

(1) The selection of the apprentice.

(2) The development or training of the apprentice.

The importance of careful selection of raw material cannot be too strongly emphasized, for upon it depends the ultimate success of the trained mechanic. Raw material suitable for apprenticeship must possess a reasonably good education (by which is meant, at least, completion of grammar school work) and show sufficient interest in the trade to warrant the employer in assuming the burden of training him in his particular trade, and not as is often the case, of merely serving out time and then leaving the service entirely on completion of the period of indenture. By investigating the environment in which a boy has been raised, his natural bents or aptitudes, and the general attitude of the parents or guardians toward the proposed trade a considerable gain can be made in the selection of proper material. Even with this preliminary investigation, a probationary period of service ranging from 30 to 90 days is of advantage to both the employer and apprentice in observing the development of dispositions and temperaments which have hitherto been dormant and which will later on have an important bearing on the quality of apprentice.

Again, it would appear that a systematic method of personal canvass of schools where prospective candidates for apprenticeship are to be found, by officials in charge of apprentice instruction, would be of considerable aid in education of the adolescent to the appreciation of the value of a trade in his life's work. By setting forth the advantages of a trade, the advantages to be derived from the system of apprentice instruction, the opportunities for advancement, and the assurance of steady employment, it is possible to stir up sufficient interest in the trades to guarantee the railroad an ample supply of high class mechanics.

The real work, however, begins after the boy enters the service as a full fledged apprentice, for from then on the quality of mechanic developed lies largely in the hands of the railroad through its instruction staff.

The assignment of the apprentice should, as far as possible, follow a systematic course to eliminate any tendency toward holding the boy too long at a particular machine or job to the detriment of other phases of instruction and to the disadvantage of other apprentices.

It is advisable that, in conjunction with the shop work or manual training which the apprentice receives, a considerable amount of classroom work and instructions should be given, so as to really make the apprenticeship school a sort of continuation school wherein the value of various methods of shop operations and the principles underlying them can be taught.

A regrettable condition of apprenticeship is often found wherein the apprentice is taken on, not so much with a view toward developing a mechanic for the future as toward filling a present day need for low-priced labor to the disadvantage of both employer and employee.

The development of the apprentice rests to a considerable degree on the personal qualities of the apprentice instructor—his temperament, characteristics and enthusiasm in the work and welfare of those in his charge. By taking advantage of one of the predominating traits of adolescence—imitation—it is possible to thoroughly enthuse the boy in his work and in that way unconsciously have him striving to attain his highest efficiency. Instruction, which fails to include the historical and economic development of railroads, the improvements introduced from time to time, and the needs for future development, fails to give the apprentice a broad view of the field of his chosen occupation and it is not surprising that in such instances gross lack of enthusiasm is to be found.

Personal attention on the part of officials, and especially those from other shops, to the character of work done by the apprentice, as well as the mechanic, is bound to promote enthusiasm.

In order to develop a high grade apprentice sufficiently great incentives must be furnished and, of these, perhaps the most effective is that of increase in wages, or an early release from the period of indenture. Further, scholarships in technical schools are often given as rewards for highly satisfactory service. Incentives of this type are always productive of excellent results, as is borne out by experience on roads offering them.

GIVE THEM RESPONSIBILITY

BY CARLETON K. STEINS
Special Apprentice*, Pennsylvania Railroad, Altoona, Pa.

Apprentices should be handled in a manner that will arouse in them a genuine interest in their trade from the beginning, and hold it there. Interest in what they are doing will automatically produce better mechanics than the most painstaking arrangement of duties, which does not consider this as of first importance. It is a rare man, much less a boy, who can concentrate and give his best efforts without possessing some degree of enthusiasm for his work.

How to maintain interest in the apprentice's mind after the newness of things has worn off is the problem that should be constantly before every employer of apprentices. The best way that I know is to place responsibility on the young man, and give him tasks that carry with them an assumption that he has ability and initiative which his boss intends making good use of. The average boy will not betray this confidence; he will put his best shoulder to the wheel to do the job as the boss wants it and will take a pride in the finished work. Here you have the earnest effort that keeps a boy from becoming disheartened, and at the same time molds the best mechanic.

Responsibility should be placed on the apprentice as far as his ability warrants. Good business sense, if no other consideration, demands it. It is essential that the assignor of tasks to apprentices be broad-minded enough to size up the boys and get a fairly accurate measure of each one's ability and then this estimate should be his guide in directing their work.

Feeling as I do that the apprentice problem is more of a human one than of curriculum (the most studied and best organized courses have something lacking) I would warn against tactlessness on the part of the apprentice's immediate boss. Tactlessness, for instance, that goes into minute instructions and even demonstrations when an apprentice is being assigned a task, a task whose main operations the boy must have performed before, or at least observed their performance. A boy who is any good at all likes to do his own thinking—he cannot take interest and pride in a job in which no detail has been left to him to decide.

Keep apprentices away from piece-workers whenever possible; pieceworkers are usually too busy to show things, much less allow the boy to do things for himself. Letting the boys actually perform operations themselves cannot be urged too strongly—it has an influence for which no amount of observing can be substituted. The pieceworker's motto, "Good enough is best," may be permissible from an economic point of view, but it is a bad one to train a good mechanic on.

*Not written from that viewpoint, however.

"Big Bill" Agnew and "Blue Monday"

A True Story, Showing Clearly the Relation of the Engine House Organization to Engine Failures

BY HARVEY DE WITT WOLCOMB

[This contribution was inspired by recent comments on engine failures in the Mechanical Edition. "Blue Monday" is known generally as the bad day in the roundhouse, and this story gives a remedy for it.—Editor.]

It was another "blue Monday" in the big roundhouse of the X, Y & Z R. R. at Greenfield, and even the elements seemed to combine their efforts to make it as "blue" as possible. It was one of those late winter days of March, when there was about 4 in. of slush on the ground, besides trying mighty hard to rain; but being too cold for rain it was more like hail.

Everything was covered with a thin coating of ice and the engines coming into the roundhouse were packed with snow; on top of this the heating system of the house was nearly out of commission and badly in need of repairs which had been neglected during the previous winter because of the rush of regular routine business and also on account of a rigid economy rule that had been in effect since the change of management. Such conditions as these were bad enough under ordinary circumstances, but on this particular morning the general roundhouse foreman, "Big Bill" Agnew, must "have gotten up out of the wrong side of the bed," as one of the machinists said, for Big Bill was sure "up in the air."

The fact is that Bill did get up a little late and had to swallow his breakfast in a hurry in order to get to work on time. When he started to check up the house for the day's work he was unable to locate his day foreman, but found everything completely disorganized, as usual. About 8 o'clock he got a telephone message that the foreman's wife was sick and that he would not be to work that day. This meant that the general roundhouse foreman would have to handle the regular day foreman's work in addition to his own numerous duties, and the two jobs combined were enough to drive a man crazy.

Lately it had seemed as if he would go crazy anyway, as engine failures were getting to be far too frequent to suit the management, and yet they were apparently tying his hands by cutting down his force and not carrying sufficient stock in the storehouse. Big Bill would not give in, though, for he knew that railroad men for miles around regarded him as one of the best "fighting" roundhouse foremen in the country, and he had the reputation of getting out of more work reported by the engineers than any other foreman on the system.

However, reputation was not helping him lately for he was getting up against it harder every day. Sometimes he thought that 12 hours a day, every day in the week, was too much for his physical strength, yet he wasn't loosing any weight. He was still six feet tall and weighed 198 pounds, the same as he had for the past five years since first taking the job. Then again he thought that perhaps his inspectors, or box packers, or some of the other mechanics, were "laying down" on him, but this could not be true, for some of them had been working on their jobs for the past 15 years; in fact, were old shop mates of his before he was promoted, and he knew them to be faithful and loyal to his interests. He did realize, however, that the type of engines had changed materially in the past four years, being heavier and more complicated, and although he had carefully studied the new and improved equipment, it was getting the best of him, or his organization, and engine failures were a daily occurrence.

However, this morning Bill was far too busy to even "remember" about himself, but was on the jump every minute to keep "the ball rolling." About 9 o'clock he was called to the office to explain over the 'phone all about why the crack midnight passenger train had had a hot pin failure of 25 minutes; on account of his additional duties of that morning, he was, of course, unable to say anything to the master mechanic that would tend to clear up the mystery.

Immediately after this his leading boilermaker informed him that Train 38's engine, due to leave the house at 1:30 p. m., required two new grates and there were none on hand, nor even any that could be altered so as to be used temporarily. "In fact," the boilermaker added, "the storehouse is getting worse every day and we haven't had the right shape of grate for this class of engine for over a month and I am continually altering some other type to use."

A SURPRISE FOR BILL

At this point I am unable to write just what Bill said, but will leave it to the imagination of the reader, for Bill was one of those fluent swearers that could swear as fast as a horse could trot, and the kick on supplies, coming as it did on top of the nice little "call down" he had received from the master mechanic over the engine failure of the previous night, was the "straw that broke the camel's back," and Bill started for the storehouse "with blood in his eye."

Going to the storehouse with a "kick" had gotten to be a regular daily habit with Bill, and he had succeeded lately in virtually driving the old storekeeper out of the service by his abuse. Recently a new storekeeper had been appointed and Bill had not run across him as yet, but was in a very good mood for a first impression. You can imagine Bill's surprise when he beheld a "slight-of-frame," young-looking man holding down the storekeeper's chair; but Bill had to take his vengeance out on someone, so he started on the new man.

What Bill said was enough. He started in on the history of storekeeping from the time of the ark down to the present time, when there "wasn't enough material of the right kind on hand to make a pair of creepers for a humming bird." During his abuse he noted with quite some surprise that the new storekeeper did not try to crawl in the wastepaper basket or slide under the desk, but simply sat still, idly glancing over some mail on his desk; these actions were such a shock to poor Bill that for once in his life he was thrown completely off the track of his thoughts and he finally stopped in confusion at a loss for proper words to express his feelings.

At this point the new storekeeper looked up at Bill and told him that he was paid to run the roundhouse and not the storehouse, and that he was going to run the storehouse in an efficient manner, which was something that Bill wasn't doing with the roundhouse. "In fact," the storekeeper said, "I have here some of the samples of your mismanagement. Here is a letter from your boiler foreman to you, asking to order 24 grates for a class of engine that has only been here once and is not liable to come again, as it is a type that cannot be used successfully on your division. I am not going to order these grates, as I don't believe you looked into the matter at all, but simply O. K.'d the order on the strength of your boiler foreman saying he wanted them. Furthermore, I intend to ship away about two-thirds of the stock we are now carrying at this point, for I am finding that about 90 per cent of the rush material you have ordered has been handled in this manner and we are showing such a large amount of material on hand that when we do ask headquarters for a rush order, they look up our stock lists and think that of the large amount of supplies we are carrying there is surely some piece that can be slightly altered to meet our rush requirements. Now, get out, for I am busy, and some day

when you are in your right mind come over and we will go over our actual requirements so as to protect ourselves against undue shortages."

Poor Bill! To be called down by a young whipsnapper like the new storekeeper was bad enough, and besides there wasn't one cuss word used for emphasis that Bill could start any argument on. It was a straight presentation of facts and Bill was big enough to realize it. In the past, with the old storekeeper on the job, he had had his own way and always had put the blame on the store department, but this new man had "shown him up" in such a strong light that there was no "come back."

Bill returned to the roundhouse and for the balance of that day really didn't know whether "he was coming or going." He could see the logic of what he had been told, yet it hurt his professional pride to think that a young man who had not been in the business very long could tell him anything about how to run a railroad. Sometimes Bill thought he would go over and clean up the floor with the new man; then again his better sense would show him that perhaps he was just a little wrong and maybe he didn't know how a storehouse should be run.

Business that day seemed to go on just as the storekeeper had inferred; that is, everything seemed to go wrong, and poor Bill was tired out when night came. After he had had supper he began to go over the events of the day and compare them with past days, and he found that every Monday was a "blue" day, and getting worse every week. When he would try to think of excuses for this and that matter, it would work out that he was the one to blame and, in fact, he saw very plainly that he was slipping back on his job, and unless some miracle happened in the near future he would be looking for a new position.

Now, Bill was no fool. In fact, he was a very bright man, and when morning came he hiked right over to the new storekeeper's office to have a sensible talk with that young man. Bill opened up by asking just what the storekeeper had meant yesterday when he accused him, the best roundhouse foreman on the system, of mismanagement?

BILL GETS SOME GOOD ADVICE

"Well," replied the storekeeper, "you are running your job on the 'one man' idea and the plant is far too big for one man to bear all of the burdens. In other words, when you stop the entire plant stops, and when you make a mistake the entire place goes to pieces, for you have not trained your help to think and plan for themselves. Take, for instance, the case you came over to see me about yesterday. That case was the oversight of your boiler foreman. Why didn't he know that there was a shortage of grates for that class of engine and hurry them up instead of waiting till they were all gone and then put the blame up to you? Why were you out of sorts yesterday and not in condition to handle one job, let alone two jobs? I know why and will tell you. Your day foreman laid off and instead of his having some man broken in to take his place in just such emergency cases, he left it up to you and you tried to hold both jobs, which didn't give you time enough to properly handle any job. You had to jump at conclusions and your foremen knew it, so they took advantage of you on everything. Take your work all the way down and you will find where you have been the 'goat' and the fellow who was actually responsible has 'slipped' it over on you."

Bill began to see a great light, and after thanking the new storekeeper for the interview he returned to his office and locked himself in for the balance of the morning.

What Bill thought of, or what he did in the office that morning, I will never know. However, it was a far different Bill that came out than the one that had gone in. From that moment he seemed possessed with only one idea and that was to take the "blue" out of "blue Monday," or any other day for that matter. He called his foremen together and lined them up to immediately break in an "understudy" or assistant foreman, and also to line up the men so that every job could be covered at a moment's notice without any confusion.

At first the foremen remonstrated, saying that it could not be done, and that some of the workmen would get "sore" if they had other men that knew all about their jobs. One foreman said that he would lose his boilerwasher at once, for that man had had his job for years and had now gotten a good thing for himself, and so should reap the benefit.

"That's just the point that I want to bring out," said Bill. "When your boilerwasher lays off we are tied up and it is up to me to answer why we are holding engines, and from now on I want at least four men broken in on some of the more important jobs." I cannot begin to tell of the things that Bill straightened out, but the results soon began to show that Bill was getting his reputation back again.

REAL CAUSE OF ENGINE FAILURES

Some months after Bill started to chase "blue Monday" I met him in the roundhouse, and such a change from the old Bill! He had changed from a man that was always in a hurry not having one moment to waste, to a man that apparently had nothing on his mind, or nothing to do. I could not help speaking about the new order of things and Bill insisted on taking me into the office to tell me how it had come about.

"Do you know," said Bill, "that I was on the road to the crazy house last spring and today I have one of the best jobs in the country. I have discovered that the real cause of engine failures is not poor engines or enginemen, but to a great extent the result of the roundhouse organization. Last spring this roundhouse was the cause of daily failures because it was being run on the one-man idea, and there was so much work for that one man that he couldn't give enough time to any one job to handle it successfully. Today everybody is working together.

"I used to be very careful to keep my office locked and not let any of my foremen see my correspondence, but today everybody has access to my office, for we are all interested in the work now. Several times my foremen have read my correspondence on different matters before I have, and the result has been that they have had a chance to work up the necessary information before I asked them for it.

"Another thing that keeps everyone in line is the assistants for every job we now have. The assistants are good men and well capable of judging their bosses' mistakes, so that keeps the boss on the jump or else the assistant will get his job.

"I found that my inspectors were not interested in their jobs, but were simply putting in ten hours' work with the only thought of protecting themselves in case any work got by them, and also to see how quickly they could get out after the six o'clock whistle blew. I put it up to them that their jobs depended on the good condition of our power and that their reputation was to be based on how the power was kept up. This meant that they would have to keep their eyes open and not only report the work, but in a way see that it was repaired properly after they had reported it. By presenting the matter in this light the inspectors saw just how they stood and began to work together.

"Last night, after six o'clock, my head inspector went over to an engine to see that some work that had been reported by him was done properly, and he did it on his own time. I told him he had better see the foreman about it, so that he would get paid for the extra time, but he wouldn't listen to it and told me that he would rather have the job right than bother with a half hour's time. You see how that works now, for this is the forty-second day that we have not had a failure of any kind.

THE ENGINEMAN "SEES A NEW LIGHT"

"There is another big wrong that I straightened out: Engineman Johnson was a 'kicker' from away back. He and I were always fighting over the jobs he wanted done that I didn't think necessary; in fact, we wasted a lot of valuable time over nothing. One day I told 'Mr. Johnson' that I was through fighting him and that from then on we would do every job that he reported.

He was so pleased to beat me that he didn't know what to do, and at first was going to have his cab painted on the inside with gold leaf and have a Brussels carpet put on the floor.

"'That's all very well, Mr. Johnson,' I said, 'we will gladly do it if you will write it down. We are going to keep an account of the cost of your engine repairs for the next year and you will be responsible for the cost outside of the few emergency repairs found by our inspectors. In other words, we intend to loan you an engine and you are to show this company whether you are a careful operator or an expensive man to have on the road.'

"You could have bought that engineman for about three cents then, for he had never thought of the cost of all the imaginary jobs he had been reporting. At first he wouldn't listen to my plan, but he finally shook hands on it and today he doesn't average two reports a week, yet he hasn't had a failure since our agreement. He used to always report a pound on the left side or an imaginary blow, but today he is mighty sure of his job before reporting it and is very proud of the low cost of his maintenance.

"This same rule worked with our 'pool' enginemen. When they found that we had each man listed by the cost to maintain the engines they were running, they soon learned to report only such jobs as were necessary and cut out a lot of reporting of imaginary pounds and blows. They found that we were doing our work well, and if they reported something it was sure to be given attention before the engine made another trip. They have learned to help themselves now and are working in our interests by trying to work in their own.

"Another thing that used to worry me a good deal was the locating of the different foremen, and I suppose they in turn had a hard time to find me when they had something to take up with me. This big roundhouse covers a lot of ground and I used to run my legs nearly off looking for this and that man. Today I have eight telephones installed around the house at different points, equipped with large gongs, and each foreman, even to myself, has a certain number of rings. Now, when I want to reach any of my foremen I have only to step to the nearest telephone and ring his number. No matter where he is he can hear his ring and will answer so that we save a lot of time in trying to find each other. This is not only a life-saver, but is also a great time-saver and paid for the installation in one month.

"I have so much time to myself now that I can personally check up my individual workmen. For instance, I found a machinist who had been working here for about three years that was not reliable. He was not turning out his work to stand up, and after several trials I had to let him go. I have hired a man in his place that is a 'dandy' and is interested in his work. This new man is not working for payday, but is working for my interest and is one of the small units that is helping to hold down our engine failures. This is the type of man that prevents engine failures, and yet some say that engine failures do not start in the roundhouse.

A DOCTOR FOR SICK JOURNALS

"I got after my box packer and told him that he was not hired to 'stick' around for 10 hours each day, but was paid to 'doctor' sick journals, and if the sick journals did not get well I would change doctors. Do you know that that man didn't even know the cost of the oil and waste he was using, although he had been packing boxes for the past 10 years? The very first month after I gave him some personal instructions in correct box packing and the economical use of oil and waste, he saved $342 for this company and I promptly raised his wages three cents an hour.

"That man has found out that it pays a good dividend to get interested in his work, and he knows that as long as he keeps the failures down and saves money in the use of oil and waste I will keep on raising his wages, even if I have to pay him 50 cents an hour. You see, I don't have to watch him now, for his work shows for itself. Before I put this plan into effect this same man was continually complaining because of the great amount of work he had to do. Very often he would look me up to tell me that some engineman had reported 'all tank cellars packed' and he knew it was unnecessary to pack those cellars. Today he is so interested in his work that I have known him to look an engine over for fear that the engineman had forgotten to report the cellars packed, or that, perhaps, he would find some little defect that he could remedy before it got out on the division and caused a failure.

"This same rule works with the house force. In the old days the house foreman was constantly complaining about how slow the engines were coming into the house from the coaling and ash pits; if I asked him to send a man out to help on the ash pit he would nearly have a fit. But today it is far different. If the ash pit or coaling pit is behind, or working short handed, my house foreman knows all about it and will send the necessary help out without saying a word to me, for he has learned that he is the man to get the benefit of the engines coming into the house on time and that the best way to overcome a grievance is to invent some scheme to overcome it.

"This roundhouse is like one big family and the success is not on account of one man, but on the united efforts of us all. My foremen don't depend on me to do their work, but are using their heads for themselves.

A MISTAKE TO PASS THE BUCK

"Talk about inventing schemes to get around some grievance; one day, in looking through my desk, I came across a big pile of inspectors' reports covering the inspection of engines that had just been turned out of the back shop. To read these reports you would naturally think that the engines were just due for general overhauling, instead of just coming out of the shop. I could not help thinking of all the time and energy wasted on them, for conditions are just the same now as they were when we first started to make these inspections. We had gotten in a 'rut' on reporting work and the back shop force looked on us as a gang of 'kickers,' so we might as well have saved our strength as to send in the reports.

"I could see that the secret of some of the bad work from the back shop was the same as in my own case, that is, the foreman had too much to look after and he couldn't give the proper time and attention to his work. Complaining of a bad job after it is done doesn't help matters, for it has cost time and money to do it wrong, and it will cost a good deal more money to make it right, so the proper time to have it made right is the first time it is being done.

"To protect myself I assigned one of my best inspectors to the back shop to follow the work as it was being done in the shop. The results of this experiment were very gratifying, for we stopped the bad work in the back shop and it is a common occurrence for us now to take an engine right out of the shop and put it out on some light run without any breaking in, as we used to do. The back shop takes the praise for this work, but we know that it was just another case of inventing a scheme to overcome a complaint instead of 'passing the buck.'

"In the storehouse we now have nearly all the material we require and yet the storekeeper informs me that we have reduced our balances by over half. I found that some foremen were simply 'hogs' when it came to ordering material. They would require five pieces of some casting and would order at least 24 pieces so as to be sure to have enough. Some of the foremen had cupboards around the house stocked up with a great number of costly finished brass parts of which they would not use more than one piece in a month; on the other hand I found some foremen that could not see far enough ahead to order the necessary castings that were required for everyday use. This has all been straightened out now and each man has been given a lesson on 'what to order,' 'when to order,' and 'how to know the cost

of too much ordering.' To-day when we ask for a rush shipment we get prompt delivery, for headquarters knows that we are on the job and what we say is 'right,' there isn't any 'come back now.'

"Knowing when you are right and saying the right thing also helps when we make any recommendation for overcoming of weak design in our engines. I never realized the vast difference of opinion that could exist among mechanics when it came to making recommendation to better a weak point in our equipment. I can see now some of the absurd recommendations that I used to send to headquarters on the suggestion of my foremen, and I don't blame the higher officers for throwing them in the waste-paper basket, for I know that they were way out of reason. To-day that kind of business has been changed and we go into everything very carefully before saying anything and the result is that when we do say something, we get prompt action.

"In conclusion, let me tell you that from my own bitter experience I know that engine failures are to a great extent caused by poor attention in the roundhouse and that roundhouse foremen are 'made' and not 'born,' as I was always lead to believe. The successful foreman is not the smooth talker or good friends to everybody, but is the man who can talk 'business' on the dollar and cents basis, and his reputation should not be based on how nice he can put the trouble 'up to the other fellow,' but on how easy he can invent some little scheme to overcome the trouble and thus cut down failures and the unnecessary throwing away of good money."

With this, Bill threw away his cigar butt and after telling me to come back some other day for the rest of his story, started out to make the rounds of one of the nicest roundhouses in the country.

RAILWAY REPAIR SHOP ORGANIZATION

BY HENRY GARDNER

The old-fashioned railroad shop organization is well known; it consisted of a shop superintendent, or master mechanic, followed in line by an assistant superintendent and general foreman and a number of shop foremen, one for each department. In a shop of this kind the superintendent, assistant superintendent and general foreman have to bear all the burdens of administration and supervision; frequently there is no assistant superintendent in the organization, the whole load being carried by the superintendent and general foreman. Under this type of strictly line organization there are great possibilities for a glaring waste of time and effort by the supervisory force. These overloaded officers, continually goaded for output, must at the same time hold discipline meetings every day and must pass on all applicants for employment; they must be familiar with all piecework schedules and continually add new prices; they must see that all belts, motors, machines and cranes are kept in repair and must handle the apprentices, constantly instructing and moving and encouraging them.

It is safe to say that no one man, or three men, can do justice to all of these duties in a shop of any appreciable size, and it is a foregone conclusion that they will frequently overlap one another in the performance of their work. An instance is recalled where three men in an old-fashioned line organization shop went over the same ground daily, one after the other, and often it was found that a sub-foreman had been told to do the same thing by each one of these three men in succession.

In the majority of railroad shops to-day the strictly line organization is in effect; there is no attempt made to plan, schedule or despatch the work in the various departments and almost any foreman can hire or discharge men, with or without just cause. The result of this state of affairs is as might be expected —low output, great waste of labor and material, with a high cost of repairs, and a general lack of system and order. The machine equipment is neglected or repaired in a makeshift manner and the money wasted in misuse and abuse of belting alone would pay for many new machines in a year. Cutting tools are dressed and hardened by guess, by the eye; no such thing as an electric furnace or a pyrometer is known.

In this same hypothetical but very typical shop, apprentices, if hired at all, are exploited by being kept on one machine for a year or more, and no serious attempt is made by any one to properly instruct them. If the shop is run on a day work basis the supervising officers must be constantly on the move to maintain the output; if the shop uses piecework to any extent an eternal personal vigilance must be exerted to keep up the quality as well as the quantity of output. These old-fashioned practices are now conceded to be wholly inadequate, especially for the larger shops, and the strictly line organization must give way to the composite line and staff organizations if the maximum quantity and quality of output, at a minimum cost, are to be obtained.

A proper organization for a large railroad locomotive repair shop is shown by the accompanying chart. Here is a combination line and staff organization. The superintendent of shops has an assistant who has a general foreman next in line in charge of all departments, as is customary. But the staff is the vital part of the whole organization, and is directly responsible for the economic and effective management of the entire plant; the line, below the superintendent, is wholly in charge of output.

On the staff are six supervisors and a chief clerk as follows: A supervisor of piecework, or other wage payment system; a supervisor of routing, scheduling and despatching in all departments; a supervisor of apprentices whose important duties are well known; a supervisor of tools and machinery in charge of the repair and purchase and installation of all new machine and hand tools, cranes, etc., about the plant; a supervisor of manufacturing who is in direct charge of all shop orders and manufactured material either for outside shops and enginehouses or for local consumption and stock, and finally a supervisor of labor, whose office may be called the employment department; this man employs and discharges all men and administers discipline for all employees in and about the plant. The duties of the chief clerk are well known and established. The form of organization shown by the chart is distinctively up-to-date and is representative of tried and successful types. With this arrangement the several and specific duties of each staff man are carefully defined and all overlapping and doubling of work by the supervising force is eliminated.

The first duty of the superintendent of a locomotive repair shop is to study quantity and quality of output. He should spend at least three-fourths of his time on this work, if he is to actually earn his salary. All clerical work, letter writing, etc., performed by a shop superintendent is a dead loss to the railroad and nine-tenths of this work should be turned over to his assistant and his chief clerk. A railroad shop superintendent has been known to spend an entire day with hammer and chisel and file surrounded by a loyal and admiring group made up of the assistant superintendent, the general foreman, the erecting shop foreman, the machine shop foreman and two skilled mechanics. But what became of the shop and the departments controlled by these men during that day? Obviously the loss to the company measured in dollars would be considerable.

The modern railroad shop superintendent must be more than a practical man and a good handler of men; he must be a superintendent in the same sense of the word as applied to similar positions in the strictly manufacturing shops. What else is a railroad shop but a manufacturing plant, and how is it in any way different in so far as opportunities for saving and economy are presented? The shop superintendent should spend a part of his time planning and developing original improvement work and he should have available up-to-date records of the output in all departments and should keep close watch over the cost of repairs. In connection with these duties the following records are

suggested for the superintendent's office; these may be expanded or modified to suit local requirements, and they are better made in chart form, as a diagram gives accurately an exact picture of conditions which cannot be so impressively presented in any other manner.

For a nine-hour day these formulae should be worked out each month and platted in diagram form:

$$\frac{\text{(1) Total engines out per month} \times 9}{\text{Total man-hours per month.}} = \text{Engines out, per man, per day.}$$

$$\frac{\text{(2) Labor cost (payroll) per mo.} \times 9}{\text{Total man-hours per month.}} = \text{Labor cost of output per man per day.}$$

$$\frac{\text{(3) Material cost per month} \times 9}{\text{Total man-hours per month.}} = \text{Material cost of output per man per day.}$$

$$\frac{\text{(4) Labor cost per month}}{\text{Engines desp. per mo.}} = \text{Labor cost per engine despatched.}$$

$$\frac{\text{(5) Material cost per month}}{\text{Engines desp. per mo.}} = \text{Material cost per engine despatched.}$$

$$\frac{\text{(6) Man-hours per month.}}{\text{Engines desp. per mo.}} = \left\{\begin{array}{l}\text{Number of hours it takes one man to turn}\\ \text{out one locomotive.}\end{array}\right.$$

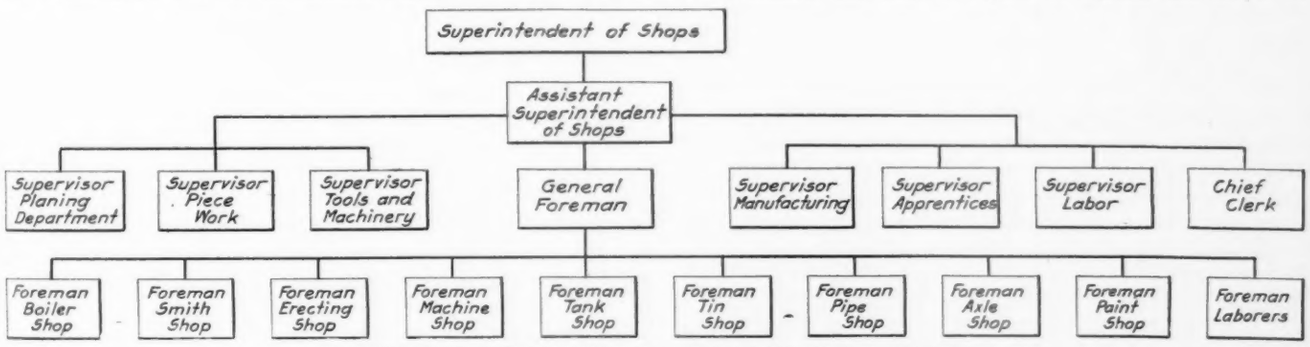
The above six formulae may be further subdivided to include each separate shop or department as the need for such data arises, or if a special study of some one department appears to be demanded by lowered output or faulty conditions. The percentage of material and labor costs should also be carefully watched and a chart may be made to show this each month. For example, the total material cost for all repairs for one month may be $30,000, and the corresponding labor cost $50,000. From this it is evident that material costs are running 37½ per cent of total and labor costs 62½ per cent, which may be considered a fairly good condition for the average shop to-day.

As indicated by the organization chart the responsibilities of the assistant shop superintendent are the same as the superintendent, since in the event of the superintendent leaving suddenly or gaining a promotion the assistant superintendent should immediately fill his superior's position without appreciably disturbing the organization or the quantity and quality of the output. The duties of the assistant superintendent should be primarily to run the shop and get the required output. He should study and arrange for the charts and data required by the superintendent and should aim in every way to run the entire plant as if his superior were not there to supervise him. A great deal of time is wasted by shop superintendents and their assistants in habitually walking about the plant visiting every department superficially each day. The gain to the shop as a whole by this procedure is practically nothing. Many a railroad shop superintendent and his assistant walk miles, day after day, conscientiously going over the same old beaten path at about the same hour at least twice each day; the foremen and workmen anticipate the visits and, of course, are all on their best behavior.

The most important duty of an assistant superintendent in any organization should be to make an exhaustive study of each department of the shop; say the boiler shop, to start with. He should turn over all other routine duties to the chief clerk and staff men and general foreman and live for a month in this department, working with the foreman as his assistant, in a sense, for the entire day, if it be from 7 a. m. to 6 p. m. In this way an exact knowledge of details may be obtained and faults corrected or eliminated which otherwise would never have been even seen. A close, individual, departmental study of this kind has never failed to result in a great reduction in manufacturing costs as well as an increase in general effectiveness and frequently a decrease in payroll as a by-product. If a month cannot be spared, two weeks, or even one week, spent by the assistant superintendent in each and every department of the plant each year will work wonders. Finally, an up-to-date shop superintendent, as well as his assistant, should visit other shops frequently and keep constantly posted as to the best methods and practices; they should also read the technical papers carefully, always watchful for labor saving devices and methods for cutting costs and eliminating wastes.

Next in line to the assistant superintendent is the general foreman. He is one of the most important men in the organization, and his duties have wholly to do with the prime object of running the shop, viz., to deliver repaired locomotives. He must be of an extremely active or motive type and must have exceptional ability for instructing and handling men and increasing production. The general foreman works with the seven staff men as occasion arises, in an advisory capacity, but he does not report to any of them or direct them. The general foreman runs the shop with a line and staff organization exactly as in the old-time line organization, with the exception that a multitude of duties are removed from him so that he becomes virtually an output specialist.

The general foreman and the supervisor of the planning department should be closely allied and preferably their offices should open together so that the daily delay reports may be taken up at once by the general foreman and the causes traced and rectified. It is good practice for the supervisor of the planning department to give the general foreman a slip each morning stating the number and class of repairs of engines that are to be brought in, and it is the duty of this office to see that the departments are at all times equalized. The duties of the staff men are indicated by their titles; the scope of this article will not admit of further details.



An Ideal Form of Organization for a Large Locomotive Repair Shop

The form of force organization required below the general foreman is so varied and depends so much upon local conditions that it must be sufficient to give simply a few general suggestions. The writer has made more than fifty individual charts for a single plant, illustrating departmental apportionment of skilled mechanics, shop hands, or handy men, and laborers; each shop must work these details out for itself—no hard and fast rules can be laid down. Great care should be taken to organize the working gangs with the proper proportion of skilled and unskilled men. Do not have sub-foremen, if needed at all, with no men reporting solely and directly to them; a sub-foreman, or assistant foreman, should always have full authority to direct the men under his charge. Workmen should not be required to report to or receive orders from more than one man, if friction is to be wholly eliminated. The working forces should be divided into small gangs under working leaders, which is better than dividing the whole responsibility between two or three leading foremen; this arrangement will cut down the cost of supervision and place the responsibility and supervision more nearly

where the work is actually performed. Specialization is undoubtedly correct for the railroad shop and it must be developed to the fullest extent in every department. Making one man responsible for one class of work not only increases his earnings and his interest in his work, but it enables him to do the best work in a manner satisfactory both to himself and to the railroad. Over specialization is preferable to under specialization.

There is always some discussion as to the relative merits or demerits of two well-known forms of erecting shop organization. The first aims to have the pits divided into blocks of six or eight pits and places one foreman in charge of each block. The other method considers the whole erecting shop as a unit, and has the foremen in charge of gangs, which do special lines of work, and travel up and down over the entire shop, visiting every pit in the order that the work is required. In a shop using a scheduling and despatching system, the former organization is preferable, since accurate comparisons of output for each foreman may be obtained and platted from month to month and a close supervision of his record is very stimulating; moreover, a friendly and healthy rivalry is maintained, thereby keeping up that all-important enthusiasm and "esprit de corps" which, after all, is the great fundamental cause for human excellence. Engines coming into the shop should be divided equally between the foremen as far as possible, so that no one man will obtain unfair advantage due to improper selection and distribution of the repairs.

More important even than the distribution of the force organization of a railroad shop is the planning and despatching department in charge of one of the staff supervisors, reporting to the assistant shop superintendent. The work of planning for the admission of engines to the shop naturally assumes more importance than the correct placing of forces, since it is easily possible to bring in too many engines requiring one kind of repairs and thereby disarrange and disorganize the most carefully planned and effective grouping of forces which may have been established to meet certain fixed conditions. The balance of a shop plays a most important part in its successful and economical administration and this is where the supervisor in charge of scheduling and despatching comes in; he must, as far as possible, keep the ratio of classified repairs constant and change that ratio only as may be necessary to prevent overloading some department which may have unexpectedly fallen behind.

For example, let us assume that a shop has been very carefully organized, a man clipped off here or added there until the entire plant is working at maximum efficiency. Then let us assume that 45 per cent of all engines turned out are to have new fireboxes, that 15 per cent are to have new cylinders, that 10 per cent are to have one or more new firebox or flue sheets, and that 30 per cent are to receive simply general repairs to machinery with flues removed and safe-ended and with tires turned. Now let us suppose that the exigencies of the service make it impossible to obtain for this shop more than 20 per cent of engines needing general repairs and that 55 per cent of all engines arriving need new fireboxes, and that 25 per cent need new cylinders; what, then, for the time being, has become of our carefully planned organization both as to men and machines? The intelligent selection of engines has a very noticeable effect on the cost of repairs as well as on the mean output; this is much more apparent in large shops where the organization is less flexible and usually highly specialized.

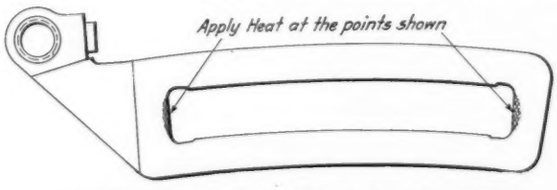
A locomotive repair shop is primarily a plant for manufacturing and maintaining power units needed for marketing the commodity, transportation, which the railroad company sells to the public, and in order to enable the company to sell its product to the best advantage the shop must at all times be ready to supply the operating department with the locomotives needed. This demand for power varies appreciably with the seasons and other causes, national and international, so that it is not always possible to keep a fixed percentage of engines of certain classes available for shopping, which have also made their required mileage in service. The division superintendent and the superintendent of motive power should, however, co-operate closely with the local shop management, as no shop can deliver a constant maximum output from month to month which will satisfy the operating officials if it is not properly supplied with the kinds of repairs for which it has been organized. The ideal state of affairs exists when engines come in for repairs in a constant flow from month to month, and there is in normal times for every railroad a nearly constant direct ratio between the number of locomotives in service and the number requiring repairs; so far as conditions will allow, this ratio should be maintained.

Planning, scheduling and routing and despatching may be depended on to suggest and create the force organization needed. To a degree the organization will automatically adjust itself to the many variable working conditions so plainly brought to light by the accurate records resulting from the systematic scheduling and routing and despatching of all operations and material through all departments of the shop. With one well-known form of modern routing system the use of the despatch board tells at once which department is late or ahead and, provided the shop is using the normal repair ratios, suggests the changes in organization or equipment necessary to build up a department and consequently equalize the shops. The best shop organization can make but an outward show of efficiency without a planning department as outlined. To the casual observer the shop may be speeded up to its maximum intensity, but a careful analysis of conditions will soon expose many weaknesses and wastes of labor and material.

Modern combination staff and line organizations must be more generally employed if our railroad shops are to keep pace with the increasing demands made by the management for reductions in maintenance costs needed to offset government regulation of freight rates and the ever-increasing demands of organized labor. Finally, the statement may now be made authoritatively that increases of output up to 25 per cent have been recorded in several large railroad shops using in greater part the modern organization described in this article, and it is beyond argument that similar or greater increases in output, with consistent decreases in labor and material costs, may be assured to any large railroad shop whose officers and their superiors have the foresight and courage to adopt these correct principles.

CLOSING VALVE MOTION LINKS WITH THE OXY-ACETYLENE TORCH

A very simple method of closing solid valve motion links is in use at the Sayre, Pa., shops of the Lehigh Valley Railroad. When doing this work by heating the link in a fire, considerable time is required and the wearing faces of the link require rehardening after the closing operation is completed. With the oxy-acetylene torch the ends of the link are heated to a red heat at the points indicated in the drawing, the depth of the heating depending upon the amount of shrinkage required to close the link to the desired dimensions. The remainder of the metal in



Link Showing the Point Where Heat is Applied

the end of the link remains cool and upsets the heated metal, which in cooling shrinks and closes the link. The time required is from five to eight minutes at each end. It is possible under certain conditions to do the work with the link in position on the engine. This method was developed by J. W. Riley, blacksmith foreman at the Sayre shops.

MASTER PAINTERS' ANNUAL MEETING

Vehicle Tests, Flat Color vs. Enamel Color, Design and Protection of Steel Passenger Cars, Piece Work

The forty-sixth annual convention of the Master Car and Locomotive Painters' Association was held at Detroit, Mich., September 14-16. H. Hengeveld, first vice-president, presided under the direction of T. J. Hutchinson, the president, who on account of illness was unable to carry on the physical duties of a presiding officer. The convention was opened with prayer, and the association was welcomed to the city by the mayor, Oscar C. Marx.

President Hutchinson, in his address, commented on the valuable work the Test Committee of the association has done in testing the various kinds of paints placed on the market for different classes of service. He favored further consideration of standard letters and numerals for stenciling all classes of freight cars, believing that there is yet much to be done in providing a more legible letter and numerals with the ultimate advantages of reducing the chances for error when recording car initials and numbers.

TEST COMMITTEE REPORT

The test committees of the several master painters' associations have devoted considerable of their time to the study and testing of the various kinds of material which make a paint pigment. This is also true of Committee D-1 of the American Society for Testing Materials. The information obtained by these tests may be summed up as follows: First, a composition paint made from a combination of several pigments will give better results than a single pigment paint; second, the pigments contained in a paint should be selected to meet the requirements of the service and the nature of the material it is expected to protect; and, third, carbon is not a rust inhibitive pigment and it is generally acknowledged that carbon paints do not make a good primer for steel, but there is no doubt but that carbon paints make the best over or body coating for steel structures exposed to the action of alkali or acids. Tests have proven that paints should be selected to meet service and climatic conditions. With these generally accepted facts as a guide it is believed that some time should be given to the study of paint vehicles.

The efficiency of linseed oil for paint purposes can be greatly increased by different forms of treatment and the treated oils properly thinned will produce a better paint vehicle at a reduced cost than can be obtained by the use of raw linseed oil.

In the development of these methods of treating linseed and other oils lies the future progress of the art of protective paint making.

The following is the report of tests of prepared films of linseed and other oils treated and non-treated:

Film 1—Linseed oil heated by electricity, and oxygen blown through it. This makes a heavy viscous oil which was mixed with equal parts of gasoline. A piece of the film weighing 27.5 grams was submerged in water for 72 hours and weighed, when taken out, 28.6 grams, increasing in weight 4 per cent.

Film 3—Linseed oil made by regular process, aged two months and then burned by special process until all the moisture had been removed and the oil had assumed a certain body. This was thinned with one part gasoline to two parts oil. A portion of film submerged in water 72 hours was found to be practically waterproof and very elastic.

Film 4—Linseed oil produced in the regular way, aged two months, then given an oxidizing treatment. This was mixed five parts oil to one of gasoline. Submerged in water 72 hours, increased in weight 3.5 per cent. The film was elastic.

Film 5—Linseed oil, aged two months, chemically treated to remove all of the mucilaginous matter and again aged four months and heated over fire from six to eight hours at a temperature of 600 degs. F. This was mixed two parts of oil to one part of gasoline. The film was submerged in water 72 hours increasing 3.95 per cent in weight. The film was elastic.

Films 6 and 7—Mixtures of China wood oil, varnish gum and linseed oil. Submerged in water 72 hours, film 6 increased 8 per cent and film 7 increased 4 per cent in weight. The films will stretch twice their own length.

Film 10—China wood oil thickened by heat and mixed 5 parts of oil to one part of gasoline. The film was submerged in water 72 hours and increased 1.9 per cent in weight.

Film 11—Linseed oil heated to a comparatively low temperature with air blown through it and mixed 5 parts of oil to two of gasoline. Increased in weight after being submerged in water 72 hours, 2.8 per cent. The film was elastic.

Film 12—Commercial boiled linseed oil. This film increased in weight 14.4 per cent after being submerged in water 72 hours. The film was very easily torn while full of water but when dry, fairly elastic.

Films 13 and 14—China wood oil and rosin heated and thinned out. These are practically waterpoof and stretch 2½ times their own length.

Film 15—Linseed oil thickened by heat and mixed three parts of oil to one part of gasoline. It increased 6 per cent of its own weight after being in water 72 hours.

Film 16—Raw linseed oil. Submerged in water 72 hours and increased 16 per cent in weight. The film was very easily torn when full of water but when dried out, fairly elastic.

Films 13 and 14 will make a waterproof paint of considerable value if mixed with the proper pigments and used in a warm climate, but are easily broken when at a temperature below freezing point. Every film mentioned above was tested at 8 deg. above zero F. Films 13, 14, 6 and 7 were as brittle as glass. All the oil films were tough and pliable. Some of the films were baked at a temperature of 135 deg. F. Practically all the air-dried films absorbed a higher percentage of water than the baked films of the same material. This demonstrates that baking closes up the pores and binds the several coats together more than the air-drying method.

The committee does not advocate the use of as high a percentage of gasoline or other thinners as were used in some of these films, as they were prepared for demonstrative purposes only, but it is contended that a heat-treated oil containing a percentage of volatile oil sufficient to make it flow freely will give better protection to steel than an oil that absorbs a high percentage of water. The results of the tests on steel plate showed this result. Twelve steel plates were prepared, the first six of which were fastened on the interior of the outside channel of a tender frame. The tank under which they were placed was in good condition and comparatively little water came in contact with them. The other six were placed under a tender in the same position, whose tank leaked and subjected them freely to water and a heavy accumulation of dirt. The paint mixed with a treated oil gave the best results. The kind of paint used and the results from corrosion are given below:

Plate 1—A combination paint with carbon and oxide of iron base, ground in linseed oil—75 per cent corroded.

Plate 2—A combination paint, oxide of iron base—10 per cent corroded.

Plate 3—A combination paint but little different from No. 2—15 per cent corroded.

Plate 4—A combination oxide of iron and red lead pigment ground in linseed oil—20 per cent corroded.

Plate 5—Composition carbon paint ground in chemically treated linseed oil—10 per cent corroded.

Plate 6—Carbon ground in linseed oil—90 per cent corroded.

Plate 7—Red lead and lamp black mixed by hand with linseed oil, not ground—total failure.

Plate 8—Carbon ground in linseed oil—total failure.

Plate 9—A chemically treated combination paint, red lead base—5 per cent corroded. (Considering service, very excellent condition).

Plate 10—Primed with a liquid primer, on one half of the plate a second coat of carbon was applied. On the other half, same as primer. The latter half was a total failure. The portion second coated with carbon—75 per cent corroded.

Plate 11—Red lead base, combination paint ground in treated oil. Second coat, carbon base, combination pigment, ground in treated oil—very little corrosion. (Considering the service, a remarkably good paint.)

A third test was made with plates treated and painted with the same material as in the previous plate test. These plates were fastened on a coach roof and used every day as the second car of a train behind a coal-burning engine. They were exposed from October 17, 1914, until August 1, 1915, and were subjected to some very severe conditions. Here, as before, the treated oil plates were in much better condition than the others. In substantiation of these conclusions quotations were

read from a paper presented by Maximilian Toch, published in the June number of the Industrial and Engineering Chemistry, and also a quotation published in the same journal from Henry A. Gardner.

One thing that must be considered is that the treatment of linseed oil as it was used in the test will not pass an analysis for pure linseed oil, and until the chemist can find a standard for analyzing this class of material the actual service this material gives must be used as the most reliable test. The committee recommends the use of a solution of ordinary blue vitriol of 10 per cent strength for washing off galvanized iron surfaces, for the purpose of roughening up the surface of the iron sufficiently to give an anchorage for the paint. Apply the solution with a brush to the galvanized surface, let it remain until fairly dry, wash off with clean water and let surface dry thoroughly. The same effect may be produced by allowing the galvanized iron to weather for a year or more or by coating the surface with copper acetole. Another mixture which will give practically the same results is made as follows:

2 oz. copper chloride
2 oz. copper nitrate
2 oz. sal-ammoniac

Dissolve in one gallon water, apply with a brush, let stand until dry, wash off thoroughly with clean water and let dry. Dust off and apply paint.

The committee showed various specimens which had been tested during the past year, which with the information regarding the way in which the paint was prepared provided very valuable information for the association. The test committee consisted of J. W. Gibbons, chairman (A. T. & S. F.); J. McCarthy (G. T.), W. H. Dutton (L. V.) and W. A. Buchanan (D. L. & W.).

FLAT COLOR VERSUS ENAMEL COLOR

M. L. Shaffer (Penn.):—It has been thoroughly demonstrated by tests extending over many years that the advantages in the use of a properly prepared varnish color are much greater than might be expected. In car work it has been the aim of the painter to make as elastic a foundation as possible. After the color has been applied it is always desired to use a rubbing varnish possessing as much durability as possible, and, of course, elasticity and durability are the main requisites of a finishing varnish. Therefore, it seems reasonable that attention be paid to the elasticity of the color coat as well as to the elasticity of the priming, surfacing and clear varnish coat. The flat colors are made by grinding the pigments in Japan, which are generally very short, and contain shellac in large proportions. We are therefore interposing between our surfacing and varnish coats a very thin, brittle, non-elastic film or color when the flat colors are used. If, on the other hand, a color is applied that has been properly mixed with a rubbing varnish in the form of an enamel the general principle of elasticity is being carried through the entire operation of painting. This, as it appears, is theoretically sound. Experience has shown that this is borne out in practice with many other distinct practical advantages which may be briefly noted as follows: First, the color being ground in varnish can be applied heavier and consequently will, especially on repair work, tend to fill up and repair any slight imperfections on the surface. Second, the varnish color will hold out the succeeding varnish coats much better than will a flat color. By the use of a standard varnish color a coat of clear finishing varnish may be entirely eliminated, thus saving the railroad not only the cost of such a coat but the labor cost of application. Third, owing to the nature of the varnish used in making these enamels the color is more permanent and much less likely to fade. With the flat color, where Japans are used, the Japans are heavily loaded with so-called driers or oxidizing agents, which naturally have in time a harmful effect on the colors or pigments which are not chemically inert. A semi-gloss leaning toward the flat is recommended, as this would dry in from three to six hours, so that there would be little loss of time in comparison with the old Japan colors.

J. B. Shuttleworth (B. & A.) also presented a brief paper on this subject, speaking strongly in favor of the enameled color rather than the old flat color, substantiating the claims made by Mr. Shaffer.

STEEL CAR DESIGN FROM A PROTECTION STANDPOINT

Two papers were presented on this subject, one by John B. Wright, of the Baltimore & Ohio, and George Warlick, of the Chicago, Rock Island & Pacific. Mr. Wright's paper is abstracted on page 525 in this issue. The following is an abstract of Mr. Warlick's paper: In the construction of steel cars the body should be as plain as possible. No countersunk rivets or butt joints should be used. The open corners should be eliminated as far as possible, as they will hold dust and moisture, ultimately causing corrosion. Sharp corners should also be eliminated, and the joints should be soldered inside and out. Better results would be obtained were the Gothic sash not used, and the deck should be plain, without projections that will hold the dust, cinders and moisture. The roofs should also be plain and made without the standing seams, and where the side and deck panels are used they should be bent in one piece. The arch type of roof has preference to the deck roof on steel equipment for this reason. Better results will be obtained if the interior of the steel car is finished in wood, as expansion and contraction on the steel finish cause the paint to crack.

Discussion.—The members spoke strongly in favor of the smooth steel sheets for passenger train cars, claiming that the extra first cost of these sheets will be fully warranted from the painting and maintenance standpoint. Some roads use aluminum doors with very great success, claiming that it is very difficult to prevent the corrosion on the inside of the steel doors. Other members also spoke strongly in favor of the canvas roof on steel equipment, and others spoke strongly against the use of screens which have been applied in many cases in the same manner as on wooden equipment. Mr. Hutchinson called attention to the stainless steel manufactured by the Firth-Sterling Steel Company, which might offer a solution to some of the difficulties experienced where excessive corrosion takes place.

PRICE VERSUS QUALITY IN BUYING PAINT STOCK

W. O. Quest (P. & L. E.):—In many instances the secret paint formulations which have been sold by reliable paint manufacturers and have proven to be of the first quality cannot be safely imitated, regardless of the claims of the imitator, whose usual effort is to make and sell his imitation at such a low price that it is almost irresistible to a close buyer. A large percentage of the successful and fast surfacing systems of to-day are the original productions of the railway car and locomotive paint shop, and, as a rule, such specialty paints are recognized for their merit and worth and not by the price they are sold for. Before the present financial depression the painter had little to complain of concerning the quality of the general paint material furnished to his department. With enforced economies have come the competition of the cheap paint stock offered by makers who evidently have not the slightest knowledge of the requirements of the paint they are selling. This has forced the old established firms, selling the old railway special paints, to cut the prices of their goods, which it is believed, has forced them to reduce the quality of their goods. The practical man in charge of the paint shop knows that something new in the form of paint or varnish is at least dangerous until it has proven its worth. Mistakes in purchasing paint material can never be remedied without large expense if the mistakes are too pronounced, as it is necessary to extensively remove this paint with a chemical remover or the burning-off torch. The painter should be consulted when a change of the quality of the paint is contemplated.

The cheap non-opaque railway body color loaded with non-

opaque fine silica is one of the worst materials the railway paint shop man has to handle. If the body color is loaded with excessively inert material it will be necessary to apply extra coats of paint to produce the uniform color effect desired, and the color will also fade more readily than the pure pigment product. The cheap poorly ground Japan usually manifests itself through its solubility, which, if pronounced, prevents a smooth color effect through the subsequent coats.

The best known special roof paints and methods of application procurable at any price are not too good for the purpose for which they are used. It is a waste of time, labor and money for a railroad company to buy a cheap roof paint which has nothing to recommend it but its low selling price. The results obtained from a cheap varnish have been a little different. The reduction in price has been met by many of the old specialty railway varnish makers, and up to date we have been agreeably surprised by the results obtained from this varnish. The freight car paint is one of the most abused of commodities. Ninety per cent of the experiments with low-priced paint have proven unsatisfactory. The first-class protective paint must be formulated out of a first-class binding oil, an oil made in Japan and the best of oil-carrying pigments regardles of color. The price of a first-class freight car paint should not be excessive, but it should not be so low as to prevent its containing the proper grade of material, as it will not prove profitable.

INTERIOR FINISH OF STEEL PASSENGER CARS

J. C. H. Kunkel (Penn.):—The steel must be perfectly free from rust, scale and acid. Apply a first-class primer, one that will maintain its elasticity for a long period, and have a tenacity that will prevent peeling and provide a foundation for the outer coats. Allow the primer 48 to 60 hours to dry, the longer the better. After the primer is dry, apply two or three coats of surfacer. It is important that the pigment be ground fine, as the protection of the steel is much greater if the particles are fine. Sand the surface with oil and No. 0 emery cloth. Two coats of straight color that have the same drying qualities as the intermediate coats is recommended. Straight color is preferable to graining or stippling, as the marred parts of the car can be repaired with far less expense and time. The color should be of a light tint, as it will not require a high finish, and will not show irregularities so prominently. After the body color has been applied, follow with three coats of varnish, one-half rubbing and one-half finishing, in order that a more elastic outer coating may be obtained. The above formula for varnish is far better than the straight rubbing, for the latter contains very little oil and is made more brittle by strong drier, and the intense moisture evaporating upon the varnished surface, tends to separate the gum from what little oil is in it, decreasing the wearing qualities still more.

The question arises right here whether too much trouble and too much expense and risk are not often involved to produce a temporary effect in finishing the interior of a car. Why not endeavor to work for the protection of the steel and durability of the painted surface, which will be practical and economical, and at the same time present a passable finish?

Discussion.—In the discussion on this subject several members stated that they had found it very difficult to make satisfactory repairs on the interior of the car where it was stippled or grained. For that reason the straight color finish is strongly favored, some members advocating the wood interior finish for that specific reason. However, as the steel equipment has not been in service sufficiently long no definite action was taken on this subject.

HANDLING PIECE WORK ACCOUNTS

Two papers were presented on this subject, one by H. Heffelfinger, of the Pennsylvania, and F. W. Bowers, of the Erie. Mr. Heffelfinger's paper is abstracted on page 526 in this issue. The following is an abstract of F. W. Bowers' remarks:

The auditing department, as a rule, prescribe the forms and system of accounting for piece work systems, and the superintendent of piece work or his equivalent usually determines and supervises the rate making after obtaining data on the actual cost of the operations. As new operations develop they should be accurately timed and a fair piece work price made on a basis of a minimum cost of production over an hour or day rate. It should be just and fair and such that a skilled workman will be able to make, by increasing the amount of work he does, a higher rate of pay. The piece work checker, or the party that assumes the responsibility for the work after the completion of each operation, should be thoroughly acquainted and familiar with the mechanical part of the operation.

Discussion.—It was pointed out that local conditions must be taken into consideration when making piece work rates, and that when new rates were being established a trial price should be applied for a certain length of time to insure that it is fair to both the men and the company, and when the price is once accepted it should be maintained. It is not believed to be feasible to limit the pay of any workman, especially in rush times; if this is done the workman will automatically decrease his pace and not turn out as much work. On the Erie when improvements are made the prices are readjusted by conference. Mr. Gibbons, of the Santa Fe, explained the workings of the bonus system and its use on that road.

VARNISH TURNING WHITE

H. M. Butts (N. Y. C.):—In order to obtain the most reliable information as to whether the roads are having any serious trouble with varnish turning white a letter of inquiry was sent to 19 different roads of the United States and Canada. Of the replies received only two were quoted as having any serious trouble, eight having very little and nine having no trouble at all. The varnishes used were of various makes of the ordinary commercial grade, ranging in price from $1.75 to $2.25 per gallon. The information received was very largely to the effect that dampness combined with very sudden changes in temperature would produce conditions which would cause the varnish to turn white. It was also shown that the cheaper grades of varnish do not recover their natural appearance as readily as do the better grades. On the whole, very little trouble is being experienced with varnish turning white with the ordinary makes of varnish used for railroad purposes.

Discussion.—The members concurred in the belief of Mr. Butts that there is no good reason for a first-class finishing varnish to turn white, although trouble has been experienced where a rubbing varnish has been applied as the finishing coat. The varnish on a locomotive tender should be allowed to be thoroughly dry before the water is placed in the tank.

MAINTENANCE OF ENAMEL COLOR VERSUS VARNISH FINISH

E. B. Stair (A. & W. P.):—When considering an exterior finish or enamel or varnish color compared to the regular varnish finish it can be said that the former will not wear or clean as easily and economically as the latter. With the enamel or varnish color the same luster is not obtained as with the clear varnish of a good quality. Several years ago a body enamel Pullman color was used on the exterior of several coaches, and it was found that the working qualities of the product were such that it was anything but a pleasure to apply, and the appearance of the job was not as satisfactory as that obtained from the varnish finish. It also did not wear as well, nor did it clean as easily nor as cheaply as the varnish finished job. We had some postal cars finished on the interior with white enamel, and it proved to be more expensive to clean than varnish over the enamel, as the dirt penetrated into the enamel, requiring considerable rubbing to get it out.

J. W. Quarles (C. & O.):—There is no question but that the varnish finish will give much better service as regards wear or durability, where the varnish is of a grade as good as the enamel or varnish color. The enamel or varnish color being

soft and easily cut will wear out more quickly with the friction of cleaning than will the varnish finish. Any color pigment or matter mixed with the varnish is certain to weaken the elasticity according to the strength of the coloring matter required to produce an opaque varnish color. If a low grade of varnish is to be used in finishing, the good grade of enamel or varnish color would be preferred on passenger equipment.

PROTECTING STEEL WITH PAINT

P. J. Burns, foreman painter at the Hoboken shops of the Pennsylvania, read a brief paper on this subject, an abstract of which follows:

The initial rusting of steel invariably commences on the sharp edges and minute projections existing on iron and steel surfaces, which proves that it is practically impossible to obtain a uniform protection when a brush is used in applying the paint. The lasting qualities of the "smalted" signs are well known. We have come to the conclusion that by substituting a very fine sawdust for the sand, using it in the same manner, and by painting over the sawdust we can secure a very much better metal protective coating. This might be carried further by having a coating of fresh paint with a substance that will completely cover the metal and fill up all the small holes and cracks, cover the rivets and in fact form a ground for the subsequent coating. There is a large variety of materials that may be used, such as abestine, cement or any inert pigment. The finishing coat can be made very heavy and applied freely so as to completely cover the material.

OTHER BUSINESS

Oscar P. Wilkins (N. & W.) recommended that standing committees be appointed to consider subjects such as passenger car roofs, proper treatment for locomotive tenders, and treatment of the interior of steel freight cars. By having five such committees with 10 or 12 members each, opinions from a greater percentage of the members will be obtained in the reports, to the ultimate advantage of the association.

T. J. Hutchinson (G. T.) revived the subject that was presented at the last year's convention regarding the lettering of freight cars. He called attention to the necessity of having legible and clearly defined letters and numerals, in order that the car foremen, inspectors and interchange men may more accurately record the numbers of the cars. He strongly recommended the use of the full face block or the Egyptian letter.

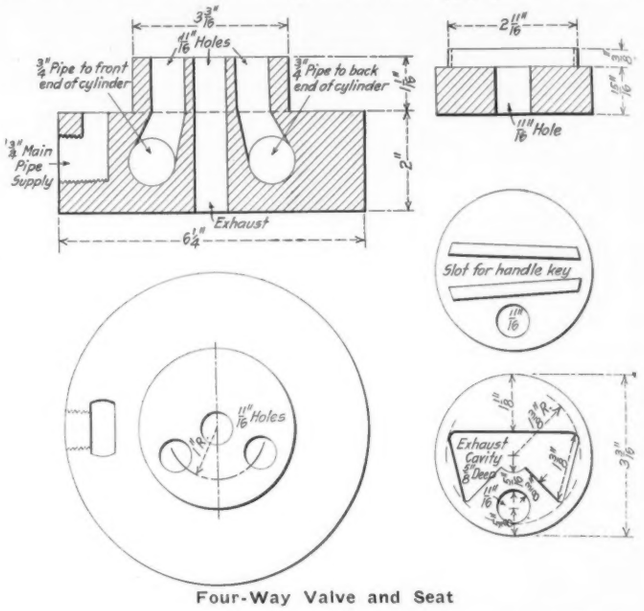
The following officers were elected for the ensuing year: President, H. Hengevelt, Atlantic Coast Line; first vice-president, John F. Gearhart, Pennsylvania; second vice-president, J. W. Gibbons, Atchison, Topeka & Santa Fe; secretary-treasurer, Albert T. Dane, Boston & Maine. The secretary reported a membership of 292. Wilmington, Del., received the largest number of votes for the next place of meeting.

ROTARY FOUR-WAY VALVE

BY E. H. WOLF

Air cylinders are extensively used about both car and locomotive repair shops to provide the necessary power for a variety of bending, straightening and forming operations. Frequently the air pressure is used in one direction only, but it is often desirable to move the piston in either direction, the air supply in such cases being usually controlled by two three-way valves, one for each end of the cylinder. The valve described herewith is designed to perform the functions of the two three-way valves with one operating handle and a three-position quadrant.

This valve is very simple and may be cheaply made. The only parts requiring finish are the valve and its seat, and for that reason they are the only parts shown in the drawing. They may be used with the cover, handle, key and washer from a Westinghouse type G-6 engineer's brake valve. The valve itself is a cast iron disk, 15/16 in. thick, upon the top of which are lugs between which the handle key is placed. The face of the valve contains an exhaust cavity, and the supply port is an 11/16 in. hole extending through the disk. The valve seat contains three ports, one in the center leading to the atmosphere and the other two leading to the cylinder pipe connections. The valve is so placed on its seat that in its central position the supply port is located



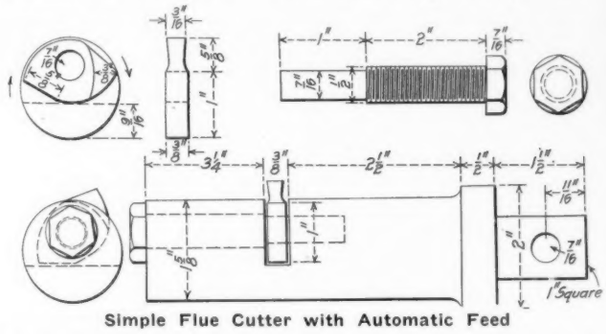
Four-Way Valve and Seat

between the two cylinder ports, both of which are located under the exhaust cavity and thus open to the atmosphere. By moving the handle from the central position in either direction the supply port is brought into register with one or the other of the cylinder ports, thus moving the piston in either direction desired. The valve may be used with cylinders up to 20 in. in diameter.

FLUE CUTTER

BY LOUIS LEBOVITZ

The drawing shows a simple device for cutting off flues at the smokebox end. It consists of a spindle 15/8 in. in diameter, at the end of which is a 1 in. square stem which may be inserted in the socket at the end of a flexible shaft. A 3/8-in. slot, 1 1/16 in.



Simple Flue Cutter with Automatic Feed

deep, is cut in the spindle 3¼ in. from the end and a ½-in. hole is bored and tapped from the end of the spindle to the slot. Beyond the slot a 7/16-in. hole extends for a distance of about 5/8 in. A cutter of the form shown in the drawing is inserted in the slot and pivoted on the end of a special bolt threaded into the end of the spindle.

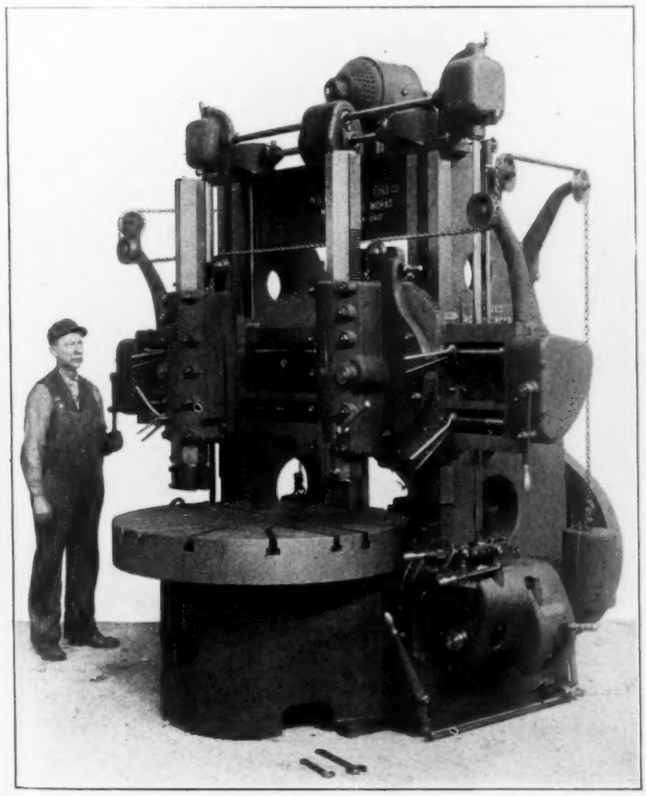
When inserted in a flue, the cutting edge of the blade projects slightly beyond the surface of the spindle. As soon as it engages the tube, however, it is gradually drawn out as the cutter revolves, thus automatically feeding into the tube. The bottom part of the cutter is so shaped that it forms a stop when in contact with the bottom of the slot in the spindle. When the tube is cut off, the motor may be reversed and the cutter withdrawn.

NEW DEVICES

BORING AND TURNING MILL

A boring and turning mill has recently been placed on the market by the Niles, Bement, Pond Co., 111 Broadway, New York, which has been especially designed to provide ease and convenience of manipulation by the operator. The machine is entirely self-contained, no parts extending below the floor line and it requires no special foundation. All changes of speed, the control of the rapid power traverse and hand adjustment of saddles and bars, the cross rail adjustment and table control are within easy reach of the operator's position. One lever disengages the feed, engages the fine and coarse feeds and operates the rapid traverse in either direction.

The housings are of the box girder form without openings in the front face. They are securely bolted to the bed of the machine and are firmly tied together at the top by a cross brace of deep section. The cross rail elevating screws are located between the housings. The table is supported by an annular bearing of large diameter running in a bath of oil. It is driven by a coarse pitch bevel gear of maximum diameter and wide space. The table spindle is long and of large diameter. It is maintained in alinement by an upper and lower bearing, the former being bored out of the solid bed and fitted with an adjustable taper bush to take up the wear. On the end of the spindle is an adjustable threaded collar to prevent lifting of the table.



Niles Boring and Turning Mill

The cross rail is of the three-track type, having a narrow guide at the bottom, with the saddle traversing screw located between the guiding surfaces. It is of the box girder form with a broad face and of great depth to withstand heavy cutting. It may readily be clamped to the housing and is provided with a power adjustment. The saddles are provided with taper gibs and may be clamped in position when the bar is feeding.

The machine may be either direct or alternating current motor driven or belt driven. For direct current it is equipped with a motor of 4 to 1 speed variation, carried on a drive plate between the housings back of the table bed. Power is transmitted through a double run of clutch gears which provide two mechanical changes in speed. With the usual 16 speeds in the controller 32 speeds are thus available at the table. The motor is fitted with push-button control and a dynamic brake for the table. The cross rail is elevated by means of a separate motor located on the housing cross brace. This motor also furnishes power for the rapid traverse of the bars and saddles. When belt or alternating current motor driven the drive is transmitted through a speed box and back gear located at the rear of the mill, which gives 12 changes of speed. A separate motor is furnished with alternating current drive for operating the cross rail and traversing the bars and saddle.

This type of machine is made in sizes which swing from 44½ in. to 74½ in., the diameter of the table ranging from 42 in. to 68 in. The driving motor horsepower required varies from 7½ for the small size machine to 12½ for the largest size.

BELT SHIFTER

The Dearborn Steel & Iron Company, Chicago, Ill., has recently placed on the market a device called the Diamond Speed Shifter, which is used for shifting the belt on any step cone belt-driven machine. As will be noticed from the illustration, the arrangement consists of two rods, one for shifting the belt to the different steps of the cone pulley on the jack shaft, and the other for shifting the belt on the cone pulley on the machine. The former consists of a rod having a ball and socket connection on the bed of the machine, the other end being fixed to the rafters from which the jack shaft is hung. Near the top of this rod an iron loop is attached, the loop passing around the belt in such position that as the rod is twisted the belt will be moved from one step to the next very readily. The arrangement for shifting the belt on the lower cone is easily understood from the illustration.

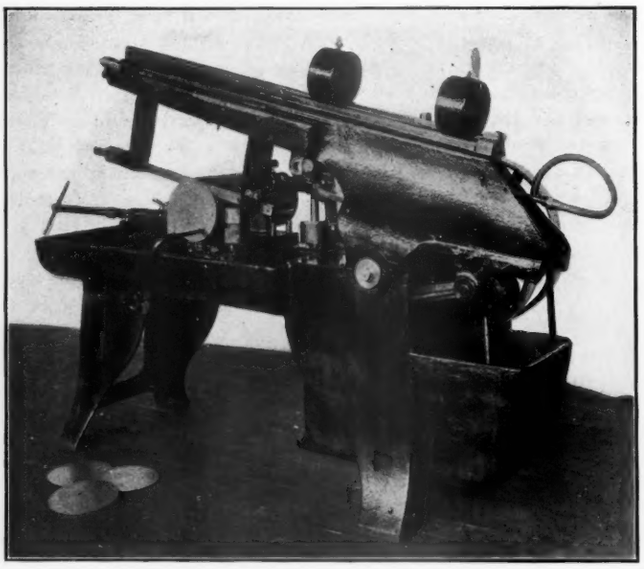
Belt Shifter for Step Cone Machines

This device presents a simple and safe way of shifting the

belt. No poles are necessary, nor is any hand work required on the belt, with the elimination of the attendant danger to the employee. It provides an ever-ready means for obtaining quickly the correct speed, thus making it easier for the workman to use the proper speed for his work. It can be operated with as much facility as is the modern gear-headed machine and brings the belt-driven machines within that category.

HIGH SPEED HACK SAW MACHINE

A heavily built high speed hack saw machine has recently been developed by the Massachusetts Saw Works, Springfield, Mass., in the design of which special care has been taken to insure rigidity and perfect alinement of the working parts. It



High Speed Hack Saw

is equipped with a number of special appliances, the purpose of which is to provide smoothness of action when starting and finishing the cut, thus removing the cause of many broken saw blades.

The machine is set low on a solid foundation with wide spread legs to give maximum rigidity. Around the bed is a large pan for cooling compound, and under the bed at the rear is an easily accessible nine-gallon tank fitted with screens to protect the pump from chips. The base, including the tank and pan, is one casting. The power head of the machine, which carries all working parts, is pivoted on the driving shaft center, thus simplifying the construction and providing for the full length stroke of the blade with the head at any angle.

The machine is intended to be driven directly from the line shaft, and two line shaft pulleys are recommended, the diameters to be proportioned to provide cutting speeds of 65 and 130 strokes per min., respectively. The change of speed is controlled by means of a lever and clutch, which may be engaged with either of two pulleys on the driving shaft of the machine. The blade is drawn instead of being pushed through the work, thus eliminating the springing action of the frame and resulting in a steadier motion to the blade under strain. The saw frame will take any blade from 12 in. to 17 in. in length, and may be quickly adjusted to any length desired. The frame bearings in the head are three-point slide bearings, of ample width provided with gib adjustment to compensate for wear. This feature, together with the flat clamps on the saw frame posts, insures perfect blade alinement and a straight cut.

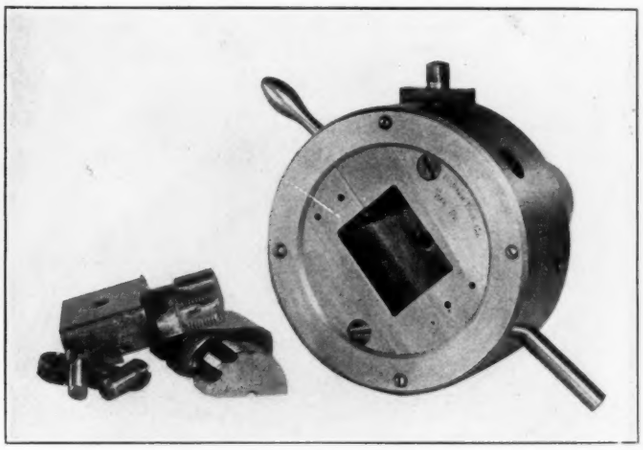
A lever controlled oil dash pot cushions the descent of the blade when it is dropped onto the work and prevents shock when the cut is completed. The blade thus gently engages the material regardless of the point from which the frame is started, without danger of breaking or stripping the teeth. An automatic patent lift and a knock-off, which operates silently and positively, are also among the special features of the machine which tend to bring about an increase in the life of the saw blades.

The vise is equipped with patent swiveled jaws. The rear jaw may be set at any angle up to 45 deg., in either direction, and the front or sliding jaw is self-adjusting, accommodating itself to the angle of the fixed jaw, or to any irregularity in the surface of the work.

The machine is designed to cut stock up to 9 in. square. For annealed and hard tool steel and steel castings the lower speed should be used, with a cooling solution. For cast iron the same speed is used, but the machine may be run without solution, while on soft machinery steel and wrought iron the solution is used with the higher speed. The pulleys are 16 in. in diameter, and take 3 in. belts.

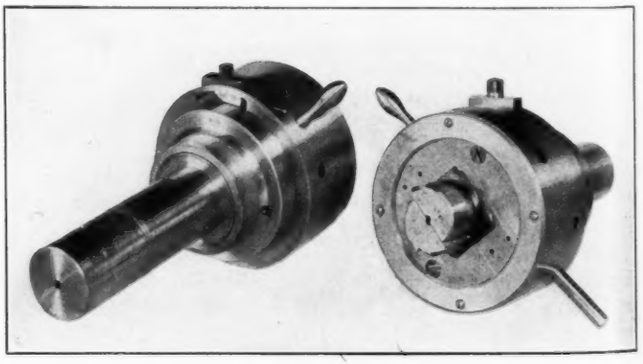
COLLAPSIBLE TAP

A collapsible tap designed to meet all requirements of internal threaded work has been developed by the Modern Tool Company, Erie, Pa. The device is simple in construction, consisting of as few parts as possible and is not easily disarranged when put into operation. It is built to have as great an amount of rigidity as the solid tap, thereby eliminating any tendency for the chasers to spring and cause taper threads.



Collapsible Tap with Chasers Removed

The construction of the tap is shown in the drawing and one

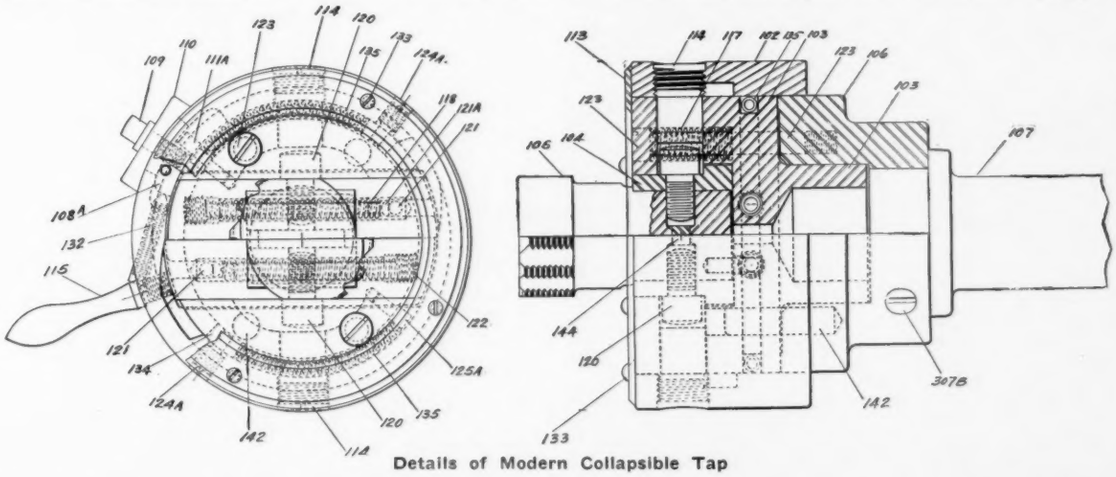


Modern Collapsible Tap

of the photographs. The tap chasers consist of two sliding pieces (105) which are a push fit in the chaser blocks (104), in which they are locked by means of two machine screws. The two chaser blocks slide in the tap head (103). The tap head

slides into the shank head (106) and is held in position by two driving studs (142); the shank head is locked solid with the shank (107). A cam ring (102) is provided outside the tap and shank heads. This ring contains two cam rises which control the position of the chaser blocks, the latter being held tightly against the cam ring by means of two springs (118).

In operation the shank is clamped in the turret of the machine and the stop on the turret set for the length of thread desired. The tap is then run up against the work, which revolves in the spindle of the machine and is fed into the work to conform to the pitch of the thread being tapped, until the stop on the turret is struck. Then the collapsible tap feeds out until the locking feather (111) releases the cam ring, which revolves and allows the two chaser blocks to slide in opposite directions, thereby collapsing the tap. After the tap has been pulled out of the threaded piece it is set for the next piece by means of the handle shown on the cam ring.



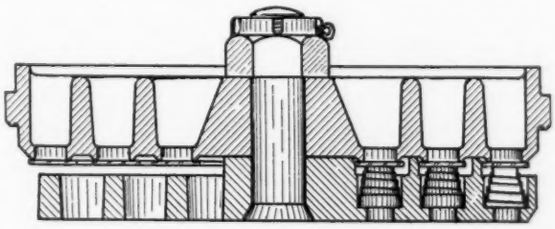
Details of Modern Collapsible Tap

This tap may be applied to hand screw machines, automatic screw machines and other types of machine where the tap is stationary and the work revolves. It may also be applied to machines where the spindle holding the tap revolves and the work is stationary, such as drill presses, by attaching a device for closing the collapsible tap automatically as it revolves.

This tap may be secured in four sizes, which have a total range from ½ in. to 3 in. The chasers are changed by removing the two chaser screws. The chasers may be ground either on the lips or on the throats the same as solid taps so that it is possible to keep as short a throat as necessary when cutting close to a shoulder.

FLAT PLATE AIR COMPRESSOR VALVES

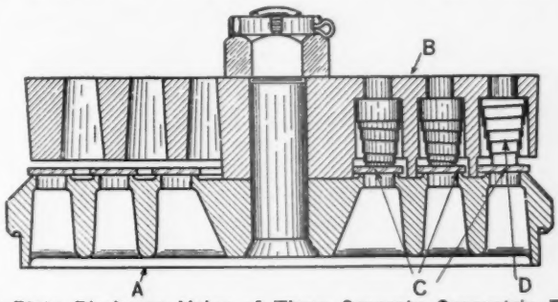
During the last few years several designs of flat plate compressor valves have been brought out, none of which have proved entirely satisfactory. The valves shown herewith, although of the flat plate type, differ considerably from those which have been previously presented, the principal feature of their construction being the use of three separate plate rings of uniform section, each of which is controlled by its own set of springs and operates entirely independently of the others.



The Inlet Valve

These valves, known as the Simplate inlet and discharge valves, are shown in the illustrations. By referring to the drawing of the discharge valve it will be seen that the device consists of a valve seat *A*, a valve keeper *B*, three flat plate ring valves *C* concentrically arranged, and the volute springs *D*, which hold the valves in position against the seat. The valve seat and keeper are held together by a special steel bolt, with a countersunk head, and a castle nut. The construction of both inlet and discharge valves is similar in detail, but they are not interchangeable, since the bolt in the discharge valve is first passed through the valve seat, while in the inlet valve it is first passed through the valve keeper. In the latter valve the valve keeper is much thinner than in the discharge valve. These differences make it impossible to inadvertently interchange the two valves, which are not meant to work interchangeably.

The inlet valve is so adjusted that the outer plate opens with a pressure of but one-quarter ounce per square inch, and but one ounce per square inch is required to open the intermediate plate. The inner plate requires a pressure of two and one-half ounces per square inch to cause it to open. The operation of the valve will thus be readily understood. At slow speeds only the outer plate will open, but as the speed increases and the volume of air to be handled becomes greater the intermediate plate will be opened, and finally for maximum performance all three plates will be in operation simultaneously. The valve plates are made of a special alloy steel, heat treated, straightened and ground true on one side only.



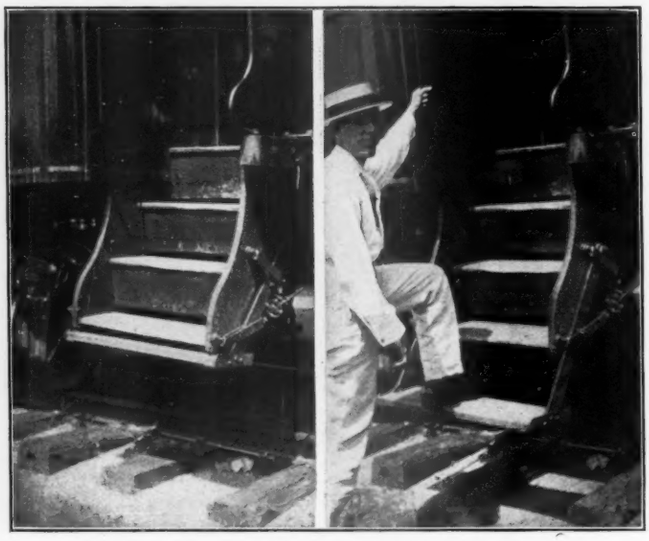
Flat Plate Discharge Valve of Three Separate Concentric Rings

The Simplate valves are the product of the Chicago Pneumatic Tool Company, Chicago, and are claimed to be much more efficient, both mechanically and volumetrically, than the old type poppet valve. With these valves the construction of the cylinders is simplified, due to the absence of intricate valve operating mechanism, and the valves require no lubrication. They are said to operate with very little noise, and the con-

struction of the valve seat and valve keeper is such as to offer the minimum restriction to the flow of air from the valve.

ADJUSTABLE CAR STEP

An adjustable bottom step for passenger coaches has recently been developed and patented by James H. Vaughan, Mobile, Ala. The device is a simple one and is easily manipulated from the



Adjustable Step in Raised and Lowered Positions

platform or vestibule of the coach. It is intended to supplant the stool or box which is now generally used at low station platforms.

The adjustable step is designed for attachment to the regular car steps and is placed below the bottom tread. It is operated by a lever placed on the end of the platform, a horizontal shaft is attached to the back side of the steps, arms at its ends connecting with the upper ends of the rods or side pieces which support the tread of the adjustable step. An arm on the shaft is connected with the lower end of the operating lever by a reach rod. When not in use the adjustable tread is raised to a point immediately below the bottom tread of the car steps. Its movement is directed by guides on the side of the car steps and is limited by stops when in its lower position.

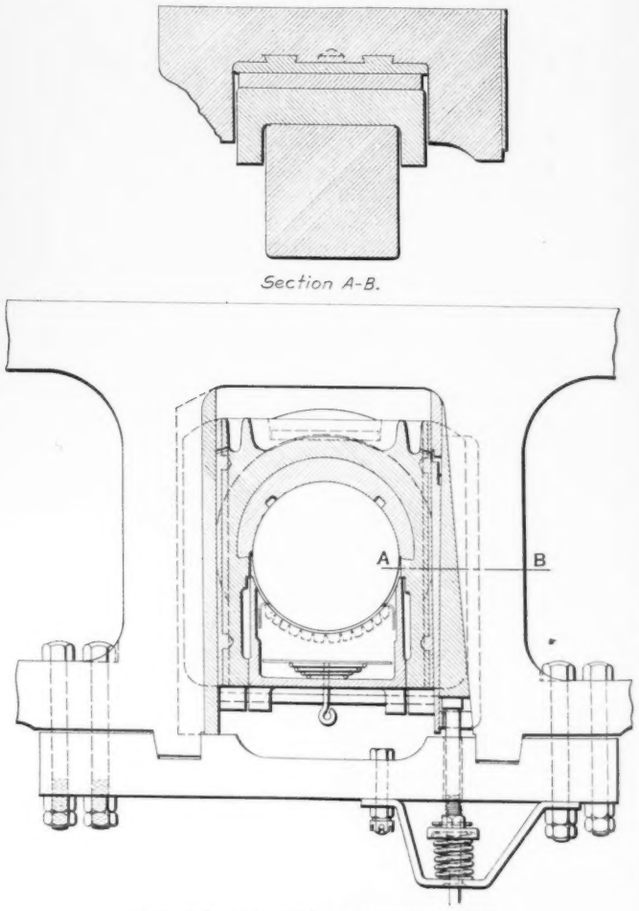
AUTOMATIC ADJUSTABLE DRIVING BOX WEDGE

A driving box wedge, designed to automatically take up the wear between the driving box and the wedge, has been placed on the market by the Franklin Railway Supply Company, New York. The device is intended to effect a material saving in labor in the roundhouse by its feature of automatic adjustment, and is also claimed to considerably increase the life of the locomotive by eliminating shocks due to stuck boxes and loose wedges with their destructive action on crown brasses and rod bushings.

The adjustable wedge consists of two parts, an adjusting and a floating wedge. The adjusting wedge is tapered on one side to conform to the taper of the jaw and on the other side to conform to the lesser taper of the floating wedge. The latter fits between the adjusting wedge and the driving box, the thin end being at the bottom. It is made one-quarter inch less in length than the distance between the top of the binder and the top of the jaw. The adjusting wedge is attached in the usual manner to a wedge bolt which passes down through the binder and a spring bracket secured to the lower side of the binder. A coil spring resting on the bracket supports the adjusting wedge by means of an adjustable collar on the wedge bolt. The tension of the spring keeps the adjusting wedge up in position, automatically taking up the slack due to wear.

In applying the wedge all surfaces are smeared with pin grease. Provision is made for the continuous lubrication of the faces of the floating wedge from the oil pocket in the top of the driving box. A cavity near the top carries oil through the wedge and distributes it over the surface bearing on the adjusting wedge.

The feature of especial importance in the operation of this device is the floating wedge and double-tapered adjusting wedge. The clearance at the top and bottom of the floating wedge allows it to move up and down slightly with the movement of



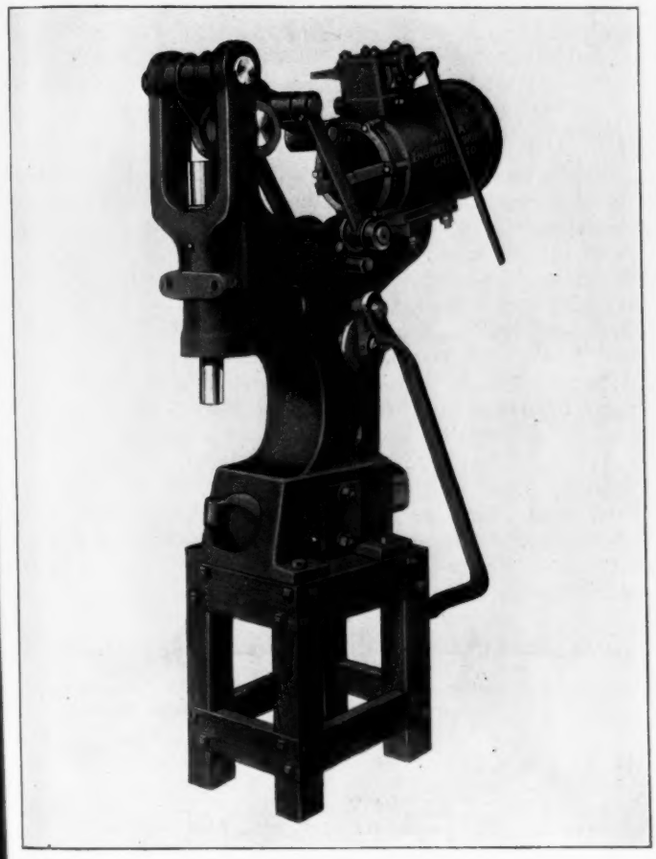
Franklin Automatic Adjustable Wedge

the box, thus eliminating all danger of the seizing of the wedge and box surfaces. Tests of the device have been made in service on a number of railroads, and the results are said to have been satisfactory in every case. Locomotives equipped with the adjustable wedge have run from shopping to shopping without the necessity of replacing rod bushings and without attention to the shoes and wedges.

Briquetting in Canada.—Peat and chalk are being extensively used, it is reported, for briquetting in Canada. The peat is mixed with coal breeze and then pressed into briquettes. Such fuel has been found efficient and economical. Chalk also, of which there are large deposits in Canada, can be converted into a profitable fuel. If the chalk is pulverized and then combined with a certain percentage of breeze and solidified tar, the mixture being compressed into small briquettes or pebbles about the size of an egg, the briquettes burn with perfect satisfaction. The fuel has the advantage of being smokeless, has a high calorific value, and burns freely.—*The Engineer.*

RIVETING MACHINE

A number of riveters of the type shown in the accompanying illustration have recently been placed in service by the Hanna Engineering Works, 2059 Elston avenue, Chicago. This type of riveter is designed for car construction work and the feature of especial interest is the removable forged steel stake. This may be shaped to any form best suited to the work on which it is to be



Hanna Riveter

used. It is particularly adapted to truck and similar work of close dimensions and may be arranged for either portable or stationary use.

The operating mechanism is of the well known Hanna type, which is designed to exert a predetermined pressure with every stroke.

Set-Screws as Rivet Sets.—A cup-pointed set-screw makes a very fair substitute for a rivet set in case of a hurry job when all the regular tools are not available.—*American Machinist.*

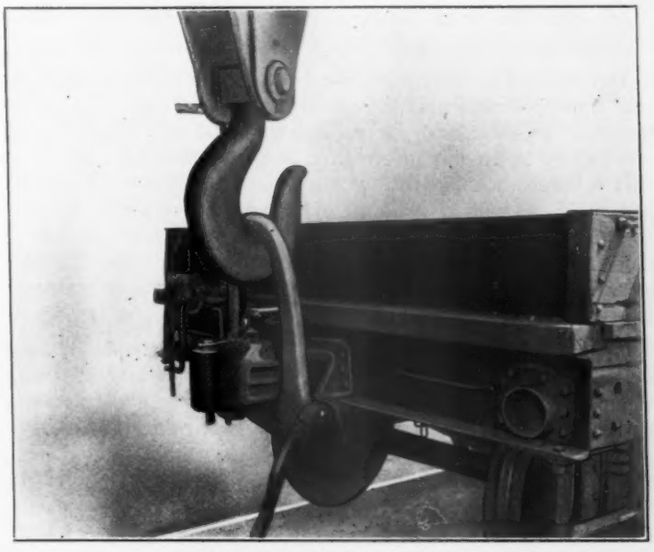
Ship Construction in the United States.—United States shipyards had under construction or contract at the beginning of the fiscal year July 1, 1915, according to data obtained by the Bureau of Navigation, Department of Commerce, 65 steel merchant vessels of 298,426 gross tons. This is the largest amount of work at the corresponding time since July 1, 1907, when 134 such vessels of 403,473 gross tons were building or contracted for. On the seaboard, however, the steel merchant construction, 60 vessels of 288,701 gross tons, is greater than in any previous year, the nearest being 63 of 273,865 tons in July, 1901. Of the vessels now building, 21 are bulk oil carriers of 154,056 gross tons, 6 colliers of 25,475 gross tons and 5 passenger steamers of 17,000 tons, the rest being cargo boats.—*Iron Age.*

SAFETY WRECKER YOKE

The illustrations show a simple wrecker yoke developed by J. W. Riley, Sayre, Pa., which has not only proven a convenient appliance for the use of the wrecking crew, but has re-

Riley Safety Wrecker Yoke

sulted in the prevention of chain breakages as well. The yoke is a solid steel casting weighing about 185 lb., and is designed to lift the heaviest loaded steel cars. It is intended to replace chains for attaching the crane hook to the car or other ob-



Wrecker Yoke in Operation

struction to be lifted where suitable projections are to be found. One of the illustrations shows the method of using the device to lift the end of a car by the coupler shank. A considerable saving of time is effected where this device replaces chains, and an increase in safety is also effected. It is now in use on a number of railroads in various parts of the country.

NEWS DEPARTMENT

The Rock Island Lines have made arrangements with the Railway Educational Bureau, of Omaha, Neb., to extend the privileges of the bureau to Rock Island employees.

The locomotive forces at the Terre Haute, Ind., shops of the Vandalia have been working on full time—54 hours per week—since the first of the month. The men in the car department have been working on this basis for some time.

Numerous facts which are of interest in connection with the movement to secure South American trade for industries in this country have been made the subject of a letter which the Pennsylvania Railroad has sent to the boards of trade of 70 cities and towns along its lines.

The stockton division, the Shasta division and the Sacramento shops have been awarded the 1915 safety banners awarded annually by the Southern Pacific Company for the greatest progress shown during the fiscal year in the furtherance of "safety first" work on the company's Pacific system.

The locomotive and car shops built by the National Transcontinental Railway Commission at Transcona, Man., and heretofore operated by the Grand Trunk Pacific, have been taken over with the National Transcontinental line east of Winnipeg for operation as part of the Canadian Government Railways.

Between Broad street, Philadelphia, and Paoli, 20 miles, the Pennsylvania Railroad is now running a few trains by electric power. The equipment of this section of the road for electric traction has been going on for about two years, and the expenditures have amounted to about $4,000,000. Current is supplied by the Philadelphia Electric Company.

The members of the Russian Imperial Railways Commission, who have been in this country for some time on business for the government-owned railways of Russia, are this week making a tour over the main line of the Pennsylvania Railroad. The commission is composed of Count S. I. Schulenburg, president; Max N. Groten, Nicolas P. Kemmer, Alphons I. Lipetz and Arkadi S. Martynoff. The principal stop will be at Altoona.

The building of the "Salt Lake Route-Union Pacific" route at the Panama-California Exposition at San Diego has been awarded a gold medal for its unique features. The building was put up to provide information to world travelers and comfort to exposition vistors. It contains a rest room for ladies and children, with a maid in attendance, information bureau and telephone booths, smoking room for gentlemen and other accommodations. The special rest room provided for the entertainment of visiting railroad men is one of the prominent features.

The Lehigh Valley Railroad, following the example of the authorities of the Pennsylvania Railroad and the city of New York, has made a thorough physical examination of all persons having to do with the preparation or serving of food in public places—that is, of all dining car employees. One hundred per cent was the condition reported. The examination included also the workers in the headquarters of the dining car department at Easton, Pa. The company had its own surgeons make the examination, and a strict standard, including personal cleanliness, was adhered to. These examinations will be made periodically.

Employees of various divisions of the Grand Trunk system are forming associations for the organization of systematic and permanent methods of contribution for war purposes. The Grand Trunk Patriotic Association of Toronto has been organized with the following officers: President, H. E. Whittemberger; chairman, G. E. Pepall; vice-chairman, W. S. Wilson; secretary, J. A. Murphy, and treasurer, J. Gray. The Barrie Division Railwaymen's Patriotic Association has also been formed, with P. J. Lynch as chairman. Subcommittees will be arranged to establish a system of monthly collections until the end of the war, the amounts realized being expended on such articles from time to time as are decided to be desirable.

To show the magnitude of automobile traffic on Long Island General Manager McCrea, of the Long Island Railroad, has had a count made of the motor cars driven across his tracks. On Sunday, August 8, at the Merrick Road crossing, in Springfield, 9,408 automobiles passed between midnight and midnight. Of these 4,245 were eastbound and 5,163 westbound. At the Barnum Island road crossing, on the Long Beach branch, 4,739 cars passed in the same period, of which 2,620 were eastbound and 2,119 westbound. In the single hour from 11 a. m. to noon on Sunday, 845 motor cars passed over the Merrick road crossing. This is at the rate of more than 14 cars a minute, or about one every four seconds. Nearly all of these cars must have crossed the Long Island tracks at other points, not once but several times. The road has been authorized by the supervisors of Nassau county to install at certain points traffic posts similar to those used by the New York City traffic squad, to serve as route indicators for motorists.

CAR AND LOCOMOTIVE ORDERS IN SEPTEMBER

During the month of September, orders for locomotives, freight cars and passenger cars were reported as follows:

	Locomotives	Freight Cars	Passenger Cars
Domestic	157	5,495	61
Foreign	47	....	..
Total	204	5,495	61

Among the more important orders for locomotives were the following: Chicago, St. Paul, Minneapolis & Omaha, 4 Pacific and 6 Mikado type locomotives, American Locomotive Company; the Texas & Pacific, 7 Santa Fe type and 6 switching locomotives, Baldwin Locomotive Works; the Servian Government, 15 Prairie type locomotives, American Locomotive Company; the Philadelphia & Reading, 20 Mikado type locomotives, Baldwin Locomotive Works; the Madrid, Saragossa & Alicante Railway of Spain, 25 12-wheel locomotives, American Locomotive Company; the Norfolk & Western, 30 Mallet type locomotives, American Locomotive Company; the Erie, 33 Santa Fe type locomotives, 18 to American Locomotive Company, 10 to Baldwin Locomotive Works and 5 to Lima Locomotive Corporation, and the Chicago & North Western, 12 Pacific type, 12 Mikado type, 10 switching and one narrow-gage locomotive, American Locomotive Company.

Among the more important freight car orders were the following: The Erie, 300 gondola cars, Standard Steel Car Company; the Atchison, Topeka & Santa Fe, 500 stock cars, Pullman Company; the Chicago & North Western, 500 ore cars, American Car & Foundry Company; the Western Maryland, 200 automobile cars, Western Steel Car & Foundry Company, and 650 gondola cars, Standard Steel Car Company, and the New York Central, 1,000 freight cars each from the Standard Steel Car Company and the Pressed Steel Car Company for the Pittsburgh & Lake Erie and 500 box cars from American Car & Foundry Company for the Cincinnati Northern.

The two largest orders for passenger cars were those of the

Central of New Jersey, which ordered 25 coaches and 5 baggage cars from the Harlan & Hollingsworth Corporation, and the Delaware & Hudson, which ordered 9 coaches and 6 baggage cars from the American Car & Foundry Company and 9 coaches from the Barney & Smith Car Company.

MEETINGS AND CONVENTIONS

Engineers' Society of Western Pennsylvania.—At the regular bimonthly meeting of the mechanical section of the Engineers' Society of Western Pennsylvania, to be held in the society rooms in the Oliver building, Pittsburgh, on October 5, will be presented a symposium on gas welding and cutting. Papers will be presented by C. K. Bryce, engineer of the Oxweld Acetylene Company, Newark, N. J., on "Use in Welding Heavy Parts;" by J. B. Henry, general superintendent of the Union Steel Casting Company, Pittsburgh, Pa., on "Use in Steel Foundries," and by A. F. Mitchell, assistant to superintendent of the armor plate department of the Carnegie Steel Company at Homestead, on "Use in Steel Mills."

The thirty-fourth annual convention of the American Electric Railway Association will be held in San Francisco, Cal., from October 4 to 8. Simultaneously there will also be held the annual conventions of the American Electric Railway Accountants' Association, the American Electric Railway Engineering Association, the American Electric Railway Claims Association, the American Electric Railway Transportation and Traffic Association and the American Electric Railway Manufacturers' Association.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, 53 State St., Boston, Mass.

AMERICAN RAILROAD MASTER TINNERS, COPPERSMITHS AND PIPEFITTERS' ASSOCIATION.—W. E. Jones, C. & N. W., 3814 Fulton St., Chicago.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—Owen D. Kinsey, Illinois Central, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Annual meeting, December 7-10, 1915, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago. Annual meeting October, 1915.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 North Fiftieth Court, Chicago. Second Monday in month, except July and August, Lytton Building, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMAN'S ASSOCIATION.—S. Skidmore, 946 Richmnod St., Cincinnati, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. G. Hall, 922 McCormick Building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1126 W. Broadway, Winona, Minn.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, Lima, Ohio.

MASTER BOILER MAKERS' ASSOCIATION.—Henry D. Vought, 95 Liberty St., New York.

MASTER CAR BUILDERS' ASSOCIATION.—J. W. Taylor, Karpen Building, Chicago.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—E. Frankenberger, 623 Brisbane Building, Buffalo, N. Y. Meetings monthly.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., East Buffalo, N. Y.

PERSONALS

It is our desire to make these columns cover as completely as possible all the changes that take place in the mechanical departments of the railways of this country, and we shall greatly appreciate any assistance that our readers may give us in helping to bring this about.

GENERAL

P. E. BAST has been appointed general fuel inspector of the Delaware & Hudson, with headquarters at Watervliet, N. Y.

W. M. SCHMALZREID has been appointed general inspector of passenger and freight cars for the Texas & Pacific at Marshall, Tex.

F. W. BOARDMAN has been appointed assistant to the mechanical superintendent of the Texas & Pacific at Marshall, Tex.

W. W. WARNER, general foreman of the Erie car repair shops at Marion, Ohio, has been promoted to the general foremanship of the steel car repair shops at Cleveland, Ohio.

W. H. OWENS, master mechanic of the Southern Railway at South Richmond, Va., has been appointed mechanical member of the valuation department of the Southern Railway.

F. O. HAYMOND, superintendent of the Bingham & Garfield Co., with headquarters at Magna, Utah, has been appointed also assistant superintendent of motive power and car departments.

H. J. WHITE, formerly general foreman, car department, Quebec grand division of the Canadian Northern at Joliette, Que., has been appointed supervisor of car work on all lines east of Port Arthur, Ont., with office at Toronto, Ont.

E. J. HARRIS, master mechanic of the Chicago, Rock Island & Pacific at Trenton, Mo., has been appointed acting mechanical superintendent of the Second district with headquarters at Topeka, Kan., succeeding G. W. Lillie, resigned.

WILLIAM C. SMITH, who was appointed assistant mechanical superintendent of the Missouri Pacific-St. Louis, Iron Mountain & Southern on September 1, was born on September 25, 1869, in Michigan. He was educated in the common schools and entered railway service on December 7, 1887. From that time until April, 1895, he served as machinist apprentice and machinist on the Missouri Pacific Railway; from April to November, 1895, he was a machinist on the Atchison, Topeka & Santa Fe; from November, 1895, to January, 1897, he was gang foreman on the Missouri Pacific at Kansas City, Mo.; from January, 1897, to January, 1902, machinist and shop foreman at Osawatomie, Kan.; January, 1902, to January, 1905, division foreman at Hoisington, Kan.; January, 1905, to February, 1906, master mechanic at Ft. Scott, Kan.; February, 1906, to July, 1912, master mechanic at Kansas City, Mo.; July 1, 1912, to September, 1915, general master mechanic of the Western division of the same road.

J. E. O'BRIEN, who has been appointed mechanical superintendent of the Missouri Pacific-St. Louis, Iron Mountain & Southern, was born on December 4, 1876, at Stillwater, Minn. He completed his education at the University of Minnesota in 1898 and in the same year entered railway service as special

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Oct. 12	Electric Lighting of Railway Cars	E. S. M. McNab	James Powell	St. Lambert, Que.
Central	Nov. 12			Harry D. Vought	95 Liberty St., New York.
New England	Oct. 19	The Architect in Railroading	L. G. Morphy	Wm. Cade, Jr.	683 Atlantic Ave., Boston, Mass.
New York	Oct. 15	The Value of Motor Cars	W. R. McKeen	Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Oct. 22	Annual Meeting		J. B. Anderson	207 Penn Station, Pittsburgh, Pa.
Richmond	Oct. 11	Signaling in General	H. W. Griffin	F. O. Robinson	C. & O. Ry., Richmond, Va.
St. Louis	Oct. 8	Fires from Locomotive Sparks	L. W. Wallace	B. W. Frauenthal	Union Station, St. Louis, Mo.
South'n & S'w'rn				A. J. Merrill	Box 1205, Atlanta, Ga.
Western	Oct. 19			Jos. W. Taylor	1112 Karpen Bldg., Chicago, Ill.
Western Canada				Louis Kon	Box 1707, Winnipeg, Man.

apprentice with the Northern Pacific at Livingston, Mont. From November 1, 1901, to November 25, 1903, he had charge of the general inspection of material and tests at St. Paul, Minn. From that time until December 1, 1904, he served as master mechanic of the Dakota division at Jamestown, N. D., following which he held the position of assistant shop superintendent at South Tacoma, Wash. From August 1, 1909, to January 1, 1910, he was mechanical engineer of the same road at St. Paul, Minn. On January 1, 1910, he became superintendent of motive power for the Western Pacific at San Francisco, Cal., and held this position until October 8, 1913, when he was appointed assistant mechanical superintendent of the Misouri Pacific, with headquarters at St. Louis, Mo. In his new capacity as mechanical superintendent Mr. O'Brien will remain in St. Louis.

W. O. THOMPSON has been appointed superintendent of rolling stock of the New York Central for the lines west of Buffalo, with headquarters at Cleveland, Ohio. Mr. Thompson was born in July, 1861, at Clayton, Mich., and was educated at Adrian, Mich., high schools. He began railway work in 1880, on the Ft. Wayne, Jackson & Saginaw, and remained with that road until it became a part of the Lake Shore & Michigan Southern. From 1884 to 1890 he served as a locomotive engineman, and then was appointed traveling engineer of the Lake Shore & Michigan Southern, remaining in that position until August, 1893. He was then engine despatcher from 1893 to 1900 on the same road. In 1901 he was appointed general locomotive inspector of the New York Central & Hudson River. The following year he was appointed superintendent of motive power on the Rome, Watertown & Ogdensburg division, and in 1907 became district master car builder at East Buffalo, N. Y., which position he held at the time of his recent appointment as superintendent of rolling stock for the New York Central lines west of Buffalo.

W. O. Thompson

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

T. A. ALBRIGHT, foreman engineer of the Texas & Pacific, has been appointed road master mechanic, with headquarters at Marshall, Tex.

R. M. BOLDRIDGE has been appointed master mechanic of the Appalachicola Northern, with office at Port St. Joe, Fla., succeeding J. P. Dolan, resigned.

JOHN R. BOWEN has been appointed assistant road foreman of engines of the Delaware & Hudson at Oneonta, N. Y., succeeding C. D. Perry, promoted.

F. C. CARLSON, assistant master mechanic of the Texas & Pacific, has resigned to become master mechanic of the International & Great Northern, with headquarters at San Antonio, Texas.

D. I. CLOUGH, master mechanic of the Oregon Electric and the United Railways, at Portland, Ore., has had his jurisdiction extended to include the Spokane & Inland Empire.

W. H. FLETCHER has been appointed district master mechanic, District No. 1, Lake Superior division of the Canadian Pacific at North Bay, Ont., succeeding L. G. Roblin, resigned.

JOSEPH PETER HEINZER has been temporarily appointed road foreman of engines of the Northern Pacific at Pasco, Wash., succeeding Robert Erwin Wilkinson.

T. C. HUDSON, division master mechanic, Quebec grand division of the Canadian Northern at Joliette, Que., has had his jurisdiction extended over the car department.

GRANT W. LILLIE has been appointed master mechanic of the Bingham & Garfield, with headquarters at Magna, Utah.

P. LINTHICUM, assistant superintendent of shops of the Chicago, Rock Island & Pacific at Silvis, Ill., has been appointed acting master mechanic of the Missouri division with headquarters at Trenton, Mo., succeeding E. J. Harris.

J. H. MCALPINE, formerly locomotive foreman of the Canadian Northern at Winnipeg, has been appointed master mechanic with jurisdiction over territory between Parry Sound, Port Arthur and Cedar Lake, Ont., with office at Parry Sound, Ont.

C. D. PERRY, assistant road foreman of engines of the Delaware & Hudson, has been appointed road foreman of engines with office at Oneonta, N. Y., succeeding O. E. Ackart, assigned to other duties.

WILLIAM VICTOR WICKS has been promoted from locomotive engineer of the Northern Pacific to the position of road foreman of engines.

CAR DEPARTMENT

G. E. DECKER has been appointed car foreman of the repair yard of the Grand Trunk Pacific at Transcona, Man., succeeding J. Reeves.

RALPH L. CHANDLER has been appointed district master car builder of the New York Central, with headquarters at East Buffalo, N. Y. Mr. Chandler was born on June 4, 1875, at Milford, N. Y., and was educated in the public and high schools of Buffalo, N. Y. He began railway work on June 28, 1891, with the New York Central & Hudson River and served as machinist's apprentice until October, 1894. He was then to December of the following year a machine hand in the mill of the Pullman Company at Buffalo. From January, 1896, to September, 1897, he was car builder with the American Car & Foundry Company, at Buffalo, and then re-entered the service of the New York Central & Hudson River as car repairer. He was promoted to foreman in January, 1898, becoming assistant general foreman in September, 1900, and three years later was appointed piecework foreman on the western division. In January, 1911, he was appointed superintendent of shops at East Buffalo, and the following August was made division general foreman of the Pennsylvania division of the same road. On October 22, 1912, he was promoted to supervisor of piecework, covering the car and locomotive departments, which position he held at the time of his recent appointment as district master car builder of the New York

R. L. Chandler

Central, with headquarters at the East Buffalo car shops, as above noted.

A. M. HILBORN has been appointed general car foreman of the Illinois Central, with office at Memphis, Tenn., succeeding E. A. Nix.

A. P. JANDER has been appointed general foreman of the Atchison, Topeka & Santa Fe at Trinidad, Col., succeeding P. B. Coffelt, deceased.

SHOP AND ENGINE HOUSE

J. J. CAREY, master mechanic of the Texas & Pacific at Marshall, Tex., has been appointed superintendent of shops in that city.

L. A. CLEARY has been appointed general foreman of the Canadian Pacific, with supervision over the back shop and roundhouse at McAdam, N. B., succeeding W. Wells, transferred.

JOHN H. PONTIUS, general engine inspector of the Pennsylvania Lines west of Pittsburgh at Columbus, Ohio, has retired after 50 years of continuous service with the road.

JOHN D. ROGERS has been appointed assistant roundhouse foreman of the Oregon Short Line, at Pocatello, Idaho.

H. SHALER has been appointed locomotive foreman of the Canadian Northern at Crowsnest, B. C., succeeding J. A. Maddick.

J. S. SCHNEIDER, machine shop foreman, has been appointed general foreman in charge of the erecting and machine shop of the Texas & Pacific at Marshall, Tex.

W. B. WOOD has been appointed acting assistant superintendent of shops of the Chicago, Rock Island & Pacific at Silvis, Ill., succeeding P. Linthicum, promoted.

G. H. LAYCOCK, heretofore locomotive foreman of the Grand Trunk Pacific at Endako, B. C., has been appointed locomotive foreman at Jasper, Alta., succeeding D. W. Hay.

PURCHASING AND STOREKEEPING

G. C. HARPKE has been appointed storekeeper of the Lake Superior division of the Northern Pacific, at Duluth, Minn., succeeding W. L. Peabody.

W. L. PEABODY, storekeeper of the Lake Superior division of the Northern Pacific, with headquarters at Duluth, Minn., has been appointed storekeeper of the St. Paul division, with office at Mississippi street, St. Paul, Minn.

OBITUARY

MENDES COHEN, a former well-known railroad engineer, died at his home in Baltimore, Md., on August 13, at the age of 84. Mr. Cohen began his career in the locomotive works of Ross Winans, at Baltimore. From 1851 to 1855 he was in the engineering department of the Baltimore & Ohio Railroad. From 1855 to 1875 he served the following companies as superintendent, assistant superintendent, controller or president: The Hudson River Railroad, the Ohio & Mississippi, and the Philadelphia & Reading; the Lehigh Coal & Navigation Company, and the Pittsburgh & Connellsville Railroad. He was long president of the Maryland Historical Society, retiring only two years ago.

J. J. MORAN, formerly master mechanic of the Houston & Texas Central at Ennis, Tex., died on July 29, at Marlow, Okla., at the age of 66 years.

FRENCH EMBARGO ON MACHINE TOOLS.—Machine tools and parts thereof have been placed on the embargo list by France, effective August 1.—*Iron Age.*

SUPPLY TRADE NOTES

C. B. Bouton, formerly president of the Union Foundry Works, Chicago, died at his home in that city on August 26.

The Boss Nut Company, Chicago, has moved its offices from the Railway Exchange Building to 1744-48 North Kolmar avenue.

The Pratt & Whitney Company, New York, has moved its Chicago sales office to the Sharples building on Washington boulevard and Jefferson street.

W. Van Ausdall, an electrical engineer of Cincinnati, Ohio, has been appointed superintendent of the C. & C. Electric & Manufacturing Company, Garwood, N. J.

E. D. Graff, for several years in the sales department of the Pittsburgh office of Joseph T. Ryerson & Sons, has been transferred to the sales department of the Chicago office.

Alexander Wilson, for many years superintendent of the railroad department of the Cambria Steel Company, died at his home in Johnstown, Pa., on August 30 at the age of 75.

The Franklin Railway Supply Company, New York, has opened an office in the Transportation building, Montreal, Canada, in charge of J. S. Coffin, Jr., Canadian sales manager.

The Loco Light Company, Indianapolis, Ind., has been incorporated for the manufacture of headlights, with a capital of $10,000, and directors, R. H. Pyle, L. J. Isbell, G. D. Thornton.

The Q & C Company, New York, has secured exclusive control of the Peffer air brake hose protector, which was previously sold by the ailway Economy Device Company, Chicago. This device will henceforth be known as the Q & C-Peffer hose protector.

David Newhall has opened an office in the Lincoln Building, Philadelphia, Pa., and represents in the eastern district the National Boiler Washing Company, and the National Waste Company, both of Chicago. Mr. Newhall will handle also various lines of railway and mill supplies.

W. H. P. Fisher has been appointed sales manager of the L. M. Booth Company of New York, manufacturers of the Booth water softeners. Mr. Fisher has been selling water softening plants to railroads for 12 years. He will make his headquarters at the company's engineering department in Jersey City, N. J.

A. Q. Tucker, vice-president of the Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio, has been elected president, succeeding M. Burr Talmage; W. G. Beebe has been elected vice-president, succeeding Mr. Tucker; F. B. McMillin continues as general manager and secretary, and M. W. Spear has been elected treasurer, succeeding H. B. McMillin.

The S. K. F. Ball Bearing Company was incorporated in Hartford, September 4, with $2,000,000 capitalization, to engage in the manufacture of ball bearings. The former American S. K. F. Ball Bearing Company has been a selling organization for the bearings made by the parent Swedish Company known as the Aktie Bolaget Svenska Kullagerfabriken of Gothenburg. The new company will build a factory at Hartford to manufacture bearings in this country, but the S. K. F. steel will be imported from Sweden.

H. M. Roberts, until recently railroad representative of the General Lead Battery Company, has been appointed sales engineer of the railroad department of the Edison Storage Battery Company, Orange, N. J. Mr. Roberts graduated in 1905 from the Sheffield Scientific School with the degree of electrical engineer, and for six years was connected with the engineering department of the New York Telephone Company in power-plant work. He later spent several years in general contracting engineering on railroad and other large enterprises with James Stewart & Co., Inc., New York.

The du Pont powder interests have made a large investment in shares of the Baldwin Locomotive Works. It has been reported that they have secured enough of the stock to give them control, but Pierre S. du Pont, the president of the du Pont de Nemours Company, has refused either to confirm or deny the report. The Baldwin Locomotive Works has been a corporation in its present form only since June 7, 1911. At that time it acquired the property of Baldwin Locomotive Works, incorporated June 7, 1909, to take over the entire property of Burnham, Williams & Co., which had been operating the business known as Baldwin Locomotive Works, founded in 1831, by Matthias Baldwin.

Edward M. Grove, treasurer of the McConway & Torley Company, Pittsburgh, Pa., died on Thursday, August 26. Mr. Grove was born in Chambersburg, Pa., on October 12, 1857. He went to Philadelphia when 14 years old and worked for a time in a printing office. In 1876 he became a telegraph operator. After three years of work as operator he was made district superintendent of the Pullman Company at Cincinnati, Ohio, and was later transferred to Jersey City, N. J. In 1886 he became assistant general manager of the Wagner Palace Car Company, with office in New York. In 1889 he resigned to become associated with the McConway & Torley Company. He has thus been 26 years with that company and for the last 15 years has been treasurer. Mr. Grove was president of the Railway Supply Manufacturers' Association in 1910 and in 1911, and devoted his time and thought generously to the interests of that association.

E. M. Grove

Roland L. Taylor, a member of the firm of William A. Read & Co., New York, has completed negotiations for the purchase of the Midvale Steel Company, Nicetown, Philadelphia, Pa., for a syndicate headed by William Ellis Corey, at one time president of the United States Steel Corporation. The Midvale Steel Company is engaged in the manufacture of axles, wheels, steel parts, forgings, etc. It is also well equipped to supply cannon, armor plate and other munitions of war, but has done but little in that line during the present war. It is expected that it will immediately secure a number of large orders for munitions. It is also rumored that the Midvale Steel Company may be but one of a number of companies which will be secured by the same interests.

The Railway Periodicals Company, Inc., has been incorporated under the laws of New York state and will henceforth publish the Railway Master Mechanic, Railway Engineering and Maintenance of Way and the Monthly Official Railway List, these papers having formerly been published by the Railway List Company, Chicago. The officers of the new company are as follows: Ernest C. Brown, publisher of Gas Age, president; Charles S. Meyers, vice-president and general manager, and S. A. Bates, secretary-treasurer. Benjamin Norton, at one time president of the Toledo, St. Louis & Western, has been made editor-in-chief, George S. Hodgins, managing editor, and Laurence A. Horswell, associate editor. The Railway Periodicals Company, Inc., will have offices in the Vanderbilt Concourse Building, New York, and that will be the office of publication.

CATALOGS

ARMCO IRON.—The American Rolling Mill Company, Middletown, Ohio, has issued a booklet describing the products made from Armco iron. This gives in some detail the various forms in which this material is produced and the manner of application in various forms of construction.

FACTORY AND OFFICE EQUIPMENT.—The Manufacturing Equipment & Engineering Company, Boston, Mass., has recently issued three books relating respectively to the company's sanitary bubbling fountains, its line of sanitary washbowls and its metal lockers for factory, office and other use.

DEFEATING RUST.—The American Rolling Mill Company, Middletown, Ohio, has issued an attractive illustrated booklet giving the story of ingot iron, describing the qualities of this material, its method of manufacture, and the various uses to which it is adapted. The book is illustrated with a number of typical illustrations of these uses.

VERTICAL OIL ENGINES.—This is the title of Bulletin No. 501, recently issued by the National Transit Company, Department of Machinery, Oil City, Pa. The booklet deals particularly with the type VT-13, two-cycle, single-cylinder, vertical oil engines, made by this company, and it contains detailed descriptions of the machine itself and its parts.

CAST IRON PIPE.—The Central Foundry Company, of New York, has issued a small pamphlet entitled, "Cast Iron Soil Pipe v. Wrought Pipe," which is devoted to a discussion of the relative durability of the two kinds of pipe as ascertained from samples of wrought iron pipe taken from the Waldorf-Astoria and of cast iron pipe taken from the old Astor House.

"SAVING SET-UPS IN RAILROAD SHOPS."—This is the title of a booklet which has recently been issued by the Lucas Machine Tool Company, Cleveland, Ohio. The booklet relates particularly to the Lucas "Precision" boring, drilling and milling machine, and aims to show wherein that machine is productive of efficiency in the railroad shop. The catalog is well illustrated and attractively gotten up.

CORROSION.—THE CAUSE, THE EFFECT, THE REMEDY.—The Stark Rolling Mill Company, Canton, O., has issued a 100-page pamphlet which calls attention to the marked increase in the tendency to corrosion attending the introduction of sheet steel manufactured by the Bessemer or open hearth processes. An account is also given of the various causes of corrosion and describes also the manner in which these troubles have been overcome in Toncon metal. Fifty pages describe and illustrate the various uses for this product.

LOCOMOTIVES.—The Baldwin Locomotive Works has recently issued Record No. 81, describing and illustrating the triple articulated or Triplex locomotive recently built by that company for the Erie, and Bulletin No. 82, showing a number of views of Baldwin locomotives for export. The former booklet contains a detailed description of the Matt H. Shay, as the locomotive has been named, well illustrated by half-tone views of the locomotive and various of its parts and line drawings showing the side elevation and cross sections. There are a number of pages dealing also with the Erie's Santa Fe type locomotives. The booklet dealing with locomotives for export contains views of a number of locomotives supplied on recent orders. The introduction touches upon the favorable position of the company as to export business and contains the interesting statement that the Baldwin Locomotive Works has been exporting locomotives since 1838, when two engines were shipped to Cuba. The illustrations given include views of the Pacific type locomotive built for New Zealand, the Pechot type locomotive built for the French government, the Mallet type engine built for the Archangel Railway of Russia, and a large number of others.